Nitric Acid, Peroxyacetyl Nitrate (PAN), and Particulate Nitrate in the Atmosphere of The City of Edmonton

RMD Report 86/35

Alberta

87-00520/

RESEARCH MANAGEMENT DIVISION EMBLEM

The emblem represents the interdisciplinary and holistic nature of the Division's environmental research programs. Each of the five sections of the symbol represent comprehensive programs on air, water, land, humans and their constant interaction. The sections converge to form a cohesive chain, characteristic of an effective research organization. This cohesive bonding makes the sections blossom into the environment in the form of a flower — an Albertan wild rose.

NITRIC ACID, PEROXYACETYL NITRATE (PAN), AND PARTICULATE NITRATE IN THE ATMOSPHERE OF THE CITY OF EDMONTON

RESEARCH MANAGEMENT DIVISION
Alberta Environment

Further information about reports published by the Research Management Division is available from:

Research Management Division
Publications Office
14th Floor, Standard Life Centre
10405 Jasper Avenue
Edmonton, Alberta
T5J 3N4

(403) 427-3946

This report may be cited as:

Peake, E., M.A. MacLean, and P.F. Lester. 1985. Nitric acid, peroxyacetyl nitrate (PAN), and particulate nitrate in the atmosphere of the City of Edmonton. Prep. for Alberta Environment, Research Management Division by the Kananaskis Centre for Environmental Research, University of Calgary. Edmonton, Alberta: Research Management Division. RMD Report 86/35. 304 pp.

This report is made available as a public service. The Alberta Department of Environment neither approves nor disagrees with the conclusions expressed herein, which are the responsibility of the authors.

NITRIC ACID, PEROXYACETYL NITRATE (PAN), AND PARTICULATE NITRATE IN THE ATMOSPHERE OF THE CITY OF EDMONTON

by

ERIC PEAKE AND M.A. MACLEAN

Kananaskis Centre for Environmental Research
The University of Calgary
Calgary, Alberta T2N 1N4

and

PETER F. LESTER

San Jose State University
San Jose, California

for
Research Management Division
Alberta Environment

1985

EXECUTIVE SUMMARY

Peroxyacetyl nitrate (PAN) was sampled every 30 minutes from 1982 December 21 to 1984 May 14 at a downtown Edmonton location (EDMU), from 1983 August 17 to September 16 and 1984 April 17 to May 15 at Fort Saskatchewan, and from 1983 July 13 to August 11 in Ellerslie.

The highest concentrations of PAN recorded were 7.51 ppb at Edmonton on 1983 August 23, 0.75 ppb at Fort Saskatchewan on 1984 April 21, and 1.30 ppb at Ellerslie on 1983 August 03. The mean concentration of PAN in Edmonton was 0.24 ppb. These concentrations are similar to those found in Calgary and are in the same range as most North American and European cities. They are far lower than concentrations in the Los Angeles Basin, where PAN concentrations of up to 65 ppb have been reported.

Concentrations of PAN in Edmonton usually increased rapidly in response to early morning emissions of primary pollutants and increasing intensity of solar radiation. Maximum PAN and ozone concentrations were most often reached in the early afternoon, but there were many exceptions, with maxima occurring as early as 0900 MST and as late as 2000 MST. PAN and ozone declined as NO_x increased. PAN often persisted overnight and, on occasion, a night-time maximum in PAN occurred. The mean daily maximum in Edmonton was 0.57 ppb.

As was the case in Calgary, PAN concentrations in Edmonton showed seasonal variations. Concentrations were highest during the late summer. Concentrations of PAN in Edmonton were limited in wintertime by the low intensity and short duration of solar radiation, and in summer by the relatively low concentration of pollutants in the atmosphere.

PAN episodes were highly correlated with the presence of anticyclonic synoptic disturbances (ridges) in the upper air flow. Surface synoptic conditions varied, but weak pressure gradients were common to all episodes. PAN occurred with both deep and shallow mixing depths.

The qualitative analysis of a simplified PAN concentration budget suggests that an important PAN source may lie just outside the city, possibly to the east and/or south.

PAN budget analysis suggests that asymmetries in daytime PAN records and spikes in the night-time records may be caused by the turbulent injection of PAN from an elevated layer into the surface layer.

During PAN episodes, synoptic disturbances both at the surface and aloft were only weakly defined, but careful analysis revealed temporally consistent and spatially coherent structures, clearly associated with mixing depth and ventilation conditions.

During some episodes the urban heat island, which commonly developed over Edmonton, included a weak circulation that influenced air trajectories passing close to the city. Some evidence of weakness in the wind fields suggests a valley circulation associated with the North Saskatchewan River.

Ozone to PAN ratios as low as 6:1 were recorded in Edmonton on days with high PAN concentrations, but ratios were commonly in the 10 to 50 range. These ratios are similar to those found in Calgary and in Los Angeles during photochemical smog episodes. Ozone to PAN ratios at both Ellerslie and Fort Saskatchewan (generally downwind of Edmonton) were high, 80:1 to 120:1 at Ellerslie, and 70:1 to 250:1 at Fort Saskatchewan, reflecting the depression of ozone by nitrogen oxide emissions in Edmonton and the generation of ozone downwind of the city.

Particulate nitrate (PN) and nitric acid (HNO_3) were sampled daily for a one-year period in Edmonton. The mean particulate nitrate concentration was 1.16 $\mu g/m^3$ and the mean nitric acid concentration was 0.30 $\mu g/m^3$. The highest PAN concentration was 8.1 $\mu g/m^3$ and the highest HNO_3 value was 2.4 $\mu g/m^3$. The concentrations are similar to those found in Calgary, and are low compared with PN concentrations found in major North American cities.

Particulate nitrate, nitric acid, PAN, and nitrogen oxides all show strong seasonal variations. Nitric acid and PAN are most abundant during the summer, when temperatures are highest and solar radiation most intense and of longer duration. Particulate nitrate and nitrogen oxides were most abundant in the winter months. PAN to PN ratios ranged from 0.74 to 17.1, HNO_3 to PN ratios ranged from 0.06 to 0.83, and PAN to HNO_3 ratios from 7.8 to 20.4. The fractional conversion of NO_x to reaction products was very low, ranging from 0.008 in December (0.8% conversion) to 0.059 in August (5.9% conversion).

PAN/nitric acid/particulate nitrate ratios indicate that PAN is the major reaction product of nitrogen oxides in the atmosphere. The decomposition of PAN may initiate the generation of nitric acid; thus, PAN may be an important agent in the long-range transport of acidic pollutants.

Current concentrations of PAN, PN, and HNO_3 in Edmonton are well below those previously reported to injure plants or present health problems except, possibly, to some highly susceptible individuals.

Based on these research findings, the following recommendations were made:

1. That further research into the chemistry and environmental effects of oxides of nitrogen be undertaken;
2. That hydrocarbons in the atmospheres of Edmonton and Calgary be characterized and quantified, that nonmetal hydrocarbons be monitored, and that sources of NO_x, SO_x, and hydrocarbons in both cities be further quantified;
3. That monitoring of PAN, nitric acid, particulate nitrate, and NO_x be continued and that monitoring stations be established in other areas of the province;
4. That integrated studies of the physics, chemistry, and meteorology of air pollution be undertaken to understand and interpret daily, monthly, and seasonal air quality observations;
5. That existing data be used to test mathematical models of the atmospheric chemistry of air pollutants and of air pollution transport, and that future measurements of atmospheric pollutants be made specifically to test existing models;

6. That the effect of urban circulation and valley circulation on pollutant concentrations be studied further and that more dense wind and pollution monitoring networks be established;
7. That short-term studies be initiated to define the vertical PAN, HNO_3, and particulate nitrate gradients and the extent of elevated PAN layers; and
8. That continuous measurements of mixing height be made to SODAR at least at EDMU and at Ellerslie to promote information about the diurnal variation and horizontal gradients of the depth of the mixed layer.

TABLE OF CONTENTS

Page

LIST OF TABLES xiii

LIST OF FIGURES xviii

ABSTRACT xxv

ACKNOWLEDGEMENTS xxvi

1. INTRODUCTION 1

2. OBJECTIVES 5

3. METHODS 6
3.1 Analysis of PAN 6
3.2 Sampling and Analysis of Particulate Nitrate and Nitric Acid 8
3.2.1 Sample Collection 8
3.2.2 Analysis of Filters 9
3.2.3 Sampling Locations and Sampling Frequency 9
3.3 Meteorological Studies 11
3.3.1 Objectives 11
3.3.2 Case Selection 11
3.3.3 Meteorological Data Acquisition 12
3.3.4 Meteorological Data Analysis 12

4. RESULTS AND DISCUSSION 16
4.1 PAN Concentrations in the Edmonton Atmosphere 16
4.2 PAN Concentrations at Ellerslie 28
4.3 PAN Concentrations at Fort Saskatchewan 37
4.4 Diurnal Variations in PAN Concentration 40
4.5 Factors Influencing PAN Formation 44
4.6 Case Studies of PAN, Ozone, and Nitrogen Oxide Relationships 45
4.6.1 Case Studies 47
4.6.1.1 Case 1, 1983 March 26 47
4.6.1.2 Case 2, 1983 April 28 50
4.6.1.3 Case 3, 1983 June 28 to 30 58
4.6.1.3.1 Case 3, Episode 1, 1983 June 28 58
4.6.1.3.2 Case 3, Episode 2, 1983 June 29 60
4.6.1.3.3 Case 3, Episode 3, 1983 June 30 64
4.6.1.4 Case 4, 1983 July 25 67
4.6.1.5 Case 5, 1983 August 02 to 05 76
4.6.1.5.1 Case 5, Episode 1, 1983 August 02 76

Continued ...

TABLE OF CONTENTS (CONCLUDED)

Page

4.6.1.5.2 Case 5, Episode 2, 1983 August 03 81
4.6.1.5.3 Case 5, Episode 3, 1983 August 04 84
4.6.1.5.4 Case 5, Episode 4, 1983 August 05 89
4.6.1.6 Case 6, 1983 August 21 to 26 95
4.6.1.6.1 Case 6, Episode 1, 1983 August 21 98
4.6.1.6.2 Case 6, Episode 2, 1983 August 22 101
4.6.1.6.3 Case 6, Episode 3, 1983 August 23 110
4.6.1.6.4 Case 6, Episode 4, 1983 August 24 114
4.6.1.6.5 Case 6, Episode 5, 1983 August 26 119
4.6.1.7 Case 7, 1984 April 19 to 21 128
4.6.1.7.1 Case 7, Episode 1, 1984 April 19 128
4.6.1.7.2 Case 7, Episode 2, 1984 April 20 131
4.6.1.7.3 Case 7, Episode 3, 1984 April 21 135
4.6.1.8 Case 8, 1984 April 27 to 28 142
4.6.1.8.1 Case 8, Episode 1, 1984 April 27 142
4.6.1.8.2 Case 8, Episode 2, 1984 April 28 149
4.6.2 Summary of Meteorological-PAN Relationships 151
4.6.3 Meteorological Contributions to PAN Events 154
4.6.3.1 Production 154
4.6.3.2 Destruction 155
4.6.3.3 Horizontal Transport 155
4.6.3.4 Turbulent Diffusion 155
4.7 Particulate Nitrate and Nitric Acid 157
4.7.1 Atmospheric Concentrations 157
4.7.2 Nitric Acid, Particulate Nitrate, NO_x, and PAN Relationships 158

5. BIOLOGICAL EFFECTS 168

6. SUMMARY AND CONCLUSIONS 170

7. RECOMMENDATIONS 173

8. REFERENCES 175

9. APPENDICES 183
9.1 Concentrations of PAN in the Edmonton Ambient Atmosphere, December 1982 to May 1984 183
9.2 Concentrations of PAN in the Fort Saskatchewan Ambient Atmosphere, August 1983 to May 1984 251
9.3 Major Ions in the Edmonton Atmosphere, November 1982 to October 1983 259

LIST OF TABLES

Page

1. Sources of Meteorological Data 13

2. Sample Station Plotting Model and Plotting Symbols Key 14

3. Weekly Means and Maxima of Atmospheric Concentrations of PAN at the Downtown Edmonton Site, January 1983 to May 1984 17

4. The Percentile Distribution Maximum Reading of PAN Measurements Made in Downtown Edmonton 1982 December 21 to 1983 May 14 19

5. Summary of Ambient PAN Monitoring in North America 29

6. Summary of World-Wide Measurements of Ambient PAN Concentrations 31

7. PAN in the Ellerslie Atmosphere, July and August 1983 32

8. The Percentile Distribution of Maximum Readings of PAN Measurements Made in Fort Saskatchewan 1983 August 17 to 1983 September 16 and 1984 April 17 to 1984 May 05 38

9. Ozone/PAN Ratios Based on Maximum Afternoon Values for Selected Days in Downtown Edmonton, Ellerslie, and Fort Saskatchewan 46

10. PAN Cases and Episodes Selected for Meteorological Analysis 48

11. Concentrations of PAN, PN, HNO_3, and NO_x in the Edmonton Atmosphere and the Fractional Conversion 159

12. Mean Monthly Total Daily Solar Radiation on Horizontal Surface, Mean Monthly Temperature, and Mean Monthly Wind Speeds at Edmonton, November 1982 to December 1983 162

13. PAN Concentrations in Downtown Edmonton, December 1982 184

14. PAN Concentrations in Downtown Edmonton, January 1983 186

Continued ...

LIST OF TABLES (CONTINUED)

Page

15. PAN Concentrations in Downtown Edmonton, February 1983 190

16. PAN Concentrations in Downtown Edmonton, March 1983 194

17. PAN Concentrations in Downtown Edmonton, April 1983 198

18. PAN Concentrations in Downtown Edmonton, May 1983 202

19. PAN Concentrations in Downtown Edmonton, June 1983 206

20. PAN Concentrations in Downtown Edmonton, July 1983 210

21. PAN Concentrations in Downtown Edmonton, August 1983 214

22. PAN Concentrations in Downtown Edmonton, September 1983 218

23. PAN Concentrations in Downtown Edmonton, October 1983 222

24. PAN Concentrations in Downtown Edmonton, November 1983 226

25. PAN Concentrations in Downtown Edmonton, December 1983 230

26. PAN Concentrations in Downtown Edmonton, January 1984 234

27. PAN Concentrations in Downtown Edmonton, February 1984 238

28. PAN Concentrations in Downtown Edmonton, March 1984 242

29. PAN Concentrations in Downtown Edmonton, April 1984 245

30. PAN Concentrations in Downtown Edmonton, May 1984 249

31. PAN Concentrations in the Fort Saskatchewan Atmosphere, August 1983 252

32. PAN Concentrations in the Fort Saskatchewan Atmosphere, September 1983 254

33. PAN Concentrations in the Fort Saskatchewan Atmosphere, April 1984 256

34. PAN Concentrations in the Fort Saskatchewan Atmosphere, May 1984 258

Continued ...

LIST OF TABLES (CONTINUED)

Page

35. Major Ions in the Edmonton Atmosphere, November 1982 (0930 0930) - Total of Teflon and Nylon Filters 260

36. Major Ions in the Edmonton Atmosphere, November 1982 (0930 0930) - Nylon Filters 261

37. Major Ions in the Edmonton Atmosphere, November 1982 (0930 0930) - Teflon Filters 262

38. Major Ions in the Edmonton Atmosphere, November 1982 (0000 2400) - Total of Teflon and Nylon Filters 263

39. Major Ions in the Edmonton Atmosphere, November 1982 (0000 2400) - Nylon Filters 264

40. Major Ions in the Edmonton Atmosphere, November 1982 (0000 2400) - Teflon Filters 265

41. Major Ions in the Edmonton Atmosphere, December 1982 (0000 2400) - Total of Teflon and Nylon Filters 266

42. Major Ions in the Edmonton Atmosphere, December 1982 (0000 2400) - Nylon Filters 267

43. Major Ions in the Edmonton Atmosphere, December 1982 (0000 2400) - Teflon Filters 268

44. Major Ions in the Edmonton Atmosphere, January 1983 (0000 2400) - Total of Teflon and Nylon Filters 269

45. Major Ions in the Edmonton Atmosphere, January 1983 (0000 2400) - Nylon Filters 270

46. Major Ions in the Edmonton Atmosphere, January 1983 (0000 2400) - Teflon Filters 271

47. Major Ions in the Edmonton Atmosphere, January 1983 (1300 1300) - Total of Teflon and Nylon Filters 272

48. Major Ions in the Edmonton Atmosphere, January 1983 (1300 1300) - Nylon Filters 273

49. Major Ions in the Edmonton Atmosphere, January 1983 (1300 1300) - Teflon Filters 274

Continued ...

LIST OF TABLES (CONTINUED)

Page

50. Major Ions in the Edmonton Atmosphere, February 1983 (0000 2400) - Total of Teflon and Nylon Filters 275

51. Major Ions in the Edmonton Atmosphere, February 1983 (0000 2400) - Nylon Filters 276

52. Major Ions in the Edmonton Atmosphere, February 1983 (0000 2400) - Teflon Filters 277

53. Major Ions in the Edmonton Atmosphere, March 1983 (0000 2400) - Total of Teflon and Nylon Filters 278

54. Major Ions in the Edmonton Atmosphere, March 1983 (0000 2400) - Nylon Filters 279

55. Major Ions in the Edmonton Atmosphere, March 1983 (0000 2400) - Teflon Filters 280

56. Major Ions in the Edmonton Atmosphere, April 1983 (0000 2400) - Total of Teflon and Nylon Filters 281

57. Major Ions in the Edmonton Atmosphere, April 1983 (0000 2400) - Nylon Filters 282

58. Major Ions in the Edmonton Atmosphere, April 1983 (0000 2400) - Teflon Filters 283

59. Major Ions in the Edmonton Atmosphere, May 1983 (0000 2400) - Total of Teflon and Nylon Filters 284

60. Major Ions in the Edmonton Atmosphere, May 1983 (0000 2400) - Nylon Filters 285

61. Major Ions in the Edmonton Atmosphere, May 1983 (0000 2400) - Teflon Filters 286

62. Major Ions in the Edmonton Atmosphere, June 1983 (0000 2400) - Total of Teflon and Nylon Filters 287

63. Major Ions in the Edmonton Atmosphere, June 1983 (0000 2400) - Nylon Filters 288

Continued ...

LIST OF TABLES (CONCLUDED)

Page

64. Major Ions in the Edmonton Atmosphere, June 1983 (0000 2400) - Teflon Filters 289

65. Major Ions in the Edmonton Atmosphere, July 1983 (0000 2400) - Total of Teflon and Nylon Filters 290

66. Major Ions in the Edmonton Atmosphere, July 1983 (0000 2400) - Nylon Filters 291

67. Major Ions in the Edmonton Atmosphere, July 1983 (0000 2400) - Teflon Filters 292

68. Major Ions in the Edmonton Atmosphere, August 1983 (1200 2400) - Total of Teflon and Nylon Filters 293

69. Major Ions in the Edmonton Atmosphere, August 1983 (1200 2400) - Nylon Filters 294

70. Major Ions in the Edmonton Atmosphere, August 1983 (1200 2400) - Teflon Filters 295

71. Major Ions in the Edmonton Atmosphere, August 1983 (0000 2400) - Total of Teflon and Nylon Filters 296

72. Major Ions in the Edmonton Atmosphere, August 1983 (0000 2400) - Nylon Filters 297

73. Major Ions in the Edmonton Atmosphere, August 1983 (0000 2400) - Teflon Filters 298

74. Major Ions in the Edmonton Atmosphere, September 1983 (0000 2400) - Total of Teflon and Nylon Filters 299

75. Major Ions in the Edmonton Atmosphere, September 1983 0000 2400) - Nylon Filters 300

76. Major Ions in the Edmonton Atmosphere, September 1983 (0000 2400) - Teflon Filters 301

77. Major Ions in the Edmonton Atmosphere, October 1983 (0000 2400) - Total of Teflon and Nylon Filters 302

78. Major Ions in the Edmonton Atmosphere, October 1983 (0000 2400) - Nylon Filters 303

79. Major Ions in the Edmonton Atmosphere, October 1983 (0000 2400) - Teflon Filters 304

LIST OF FIGURES

Page

1. Gas Chromatogram of an Ambient Air Sample 7

2. Map of Edmonton Study Area Showing Location of Wind Monitoring Sites 10

3. PAN, Ozone and NO_x Concentrations in Edmonton, 1983 March 26 41

4. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 July 25 42

5. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 March 26 49

6. Composite Surface and 500 mb Analysis for 1983 March 26 at 1700 MST 51

7. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1900 MST, 1983 March 26 52

8. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 April 28 53

9. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 April 28 54

10. Composite Surface and 500 mb Analysis for 1983 April 28 at 1700 MST 56

11. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 2000 MST, 1983 April 28 57

12. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 June 28, 29, and 30 59

13. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 June 28 61

14. Composite Surface and 500 mb Analysis for 1983 June 28 at 1700 MST 62

Continued ...

LIST OF FIGURES (CONTINUED)

Page

15. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1500 MST, 1983 June 28 63

16. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 June 29 65

17. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1030 MST, 1983 June 29 66

18. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 June 30 68

19. Composite Surface and 500 mb Analysis for 1983 June 30 at 0500 MST 69

20. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 0330 MST, 1983 June 30 70

21. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 July 25 71

22. PAN, Ozone, and NO_x Concentrations in Ellerslie, 1983 July 25 73

23. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 July 25 74

24. Composite Surface and 500 mb Analysis for 1983 July 25 at 1700 MST 75

25. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1300 MST, 1983 July 25 77

26. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 August 02 and 03 78

27. PAN and Ozone Concentrations in Ellerslie, 1983 August 02 and 03 79

Continued ...

LIST OF FIGURES (CONTINUED)

Page

28. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 02 80

29. Composite Surface and 500 mb Analysis for 1983 August 02 at 0500 MST 82

30. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 0900 MST, 1983 August 02 83

31. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 03 85

32. Composite Surface and 500 mb Analysis for 1983 August 03 at 1700 MST 86

33. Air Parcel Trajectory Terminating at the Downtown Edmonton Edmonton Air Quality Monitoring Station (EDMU at 1700 MST, 1983 August 03 87

34. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 August 04 and 05 88

35. PAN and Ozone Concentrations in Ellerslie, 1983 August 04 and 05 90

36. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 04 91

37. Composite Surface and 500 mb Analysis for 1983 August 04 at 1700 MST 92

38. Air Parcel Trajectory Terminating at the Downtown Edmonton Edmonton Air Quality Monitoring Station (EDMU) at 1300 MST, 1983 August 04 93

39. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 2100 MST, 1983 August 04 94

Continued ...

LIST OF FIGURES (CONTINUED)

Page

40. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 05 96

41. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1000 MST, 1983 August 05 97

42. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 August 21 and 22 99

43. PAN, Ozone, and NO_x Concentrations in Fort Saskatchewan, 1983 August 21 and 22 100

44. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 21 102

45. Composite Surface and 500 mb Analysis for 1983 August 21 at 0500 MST 103

46. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 2100 MST, 1983 August 21 104

47. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 22 106

48. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1300 MST, 1983 August 22 107

49. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1600 MST, 1983 August 22 108

50. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 2000 MST, 1983 August 22 109

51. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 August 23 and 24 111

Continued ...

LIST OF FIGURES (CONTINUED)

Page

52. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 23 112

53. Composite Surface and 500 mb Analysis for 1983 August 23 at 1700 MST 113

54. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1000 MST, 1983 August 23 115

55. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1200 MST, 1983 August 23 116

56. PAN and Ozone Concentrations in Fort Saskatchewan, 1983 August 23 and 24 117

56. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 24 118

58. Composite Surface and 500 mb Analysis for 1983 August 24 at 1700 MST 120

59. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1400 MST, 1983 August 24 121

60. PAN, Ozone, and NO_x Concentrations in Edmonton, 1983 August 26 122

61. PAN and Ozone Concentrations in Fort Saskatchewan, 1983 August 26 124

62. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1983 August 26 125

63. Composite Surface and 500 mb Analysis for 1983 August 26 at 1700 MST 126

64. Air Parcel Trajectory Terminating at the Downtown Edmonton Air Quality Monitoring Station (EDMU) at 1100 MST, 1983 August 26 127

Continued ...

LIST OF FIGURES (CONTINUED)

Page

65. PAN, Ozone, and NO_x Concentrations in Edmonton, 1984 April 19, 20, and 21 129

66. PAN, Ozone, and NO_x Concentrations in Fort Saskatchewan, 1984 April 19, 20, and 21 130

67. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1984 April 19 132

68. Composite Surface and 500 mb Analysis for 1984 April 19 at 1700 MST 133

69. Air Parcel Trajectories at 1800 MST, 1984 April 19 134

70. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1984 April 20 136

71. Composite Surface and 500 mb Analysis for 1984 April 20 at 1700 MST 137

72. Air Parcel Trajectories, 1984 April 20 138

73. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1984 April 21 140

74. Air Parcel Trajectories, 1984 April 21 141

75. PAN, Ozone, and NO_x Concentrations in Edmonton, 1984 April 27 and 28 143

76. PAN, Ozone, and NO_x Concentrations in Fort Saskatchewan, 1984 April 27 and 28 144

77. Composite Surface and 500 mb Analysis for 1984 April 28 at 0500 MST 145

78. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1984 April 27 147

Continued ...

LIST OF FIGURES (CONCLUDED)

Page

79. Air Parcel Trajectories, 1984 April 27 148

80. Time Series at Abbreviated Surface Airways (SA) Reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) Airports for 1984 April 28 150

81. Air Parcel Trajectories at 0900 MST, 1984 April 27 and 28 . . . 152

82. Seasonal Changes in PAN/PN and HNO_3/PAN Ratios in Edmonton, November 1982 to October 1983 163

83. Seasonal Changes in PAN/HNO_3 Ratios in Edmonton, November 1982 to October 1983 164

84. Seasonal Changes in Fractional Conversion (Fn) of NO_x to Reactive Products in Edmonton, November 1982 to November 1983 167

ABSTRACT

Nitrogen oxides (NO_x) are major air pollutants in the ambient atmosphere of Edmonton and Calgary that lead to the formation of such secondary pollutants as peroxyacetyl nitrate (PAN), nitric acid, particulate nitrate, and ozone. In high concentrations, these constituents of photochemical smog can produce adverse health, ecological, and environmental effects.

The highest PAN concentration recorded over a 14-month period in downtown Edmonton was 7.5 ppb, a concentration similar to that found in Calgary but far below the peak of 65 ppb recorded in Los Angeles, California. The mean daily maximum of 0.6 ppb was much the same as in Calgary and other North American cities, excluding California. Maximum PAN and ozone concentrations were often reached in the early afternoon but there were many exceptions with maxima as early as 0900 MST and as late as 2000 MST. PAN often persisted throughout the night in Edmonton, whereas in Calgary it disappeared rapidly in the evening. Edmonton PAN concentrations showed seasonal variation and were limited in the wintertime by the lack of solar radiation and in the summer by the low concentration of pollutants. PAN episodes were highly correlated with the presence of anticyclonic synoptic disturbances (ridges) in the upper air flow. Surface synoptic conditions varied but weak pressure gradients were common to all episodes. Occasional sudden increases in night-time PAN concentrations may be caused by turbulent injections of PAN from an elevated layer.

Particulate nitrate and nitric acid concentrations were similar to those found in Calgary and low when compared with major North American cities. The mean particulate nitrate concentration was 1.16 $\mu g/m^3$ and the mean nitric acid concentration was 0.30 $\mu g/m^3$ over a 12-month period. Peroxyacetyl nitrate:nitric acid:nitrate ratios indicate that PAN is the major product of NO_x reactions in the atmosphere, and that PAN may play a major role in the long-range transport of acid-forming pollutants. Present concentrations of PAN in Edmonton are not likely to have major environmental or human health effects, except possibly on highly sensitive areas or individuals.

ACKNOWLEDGEMENTS

We express our appreciation for the assistance provided by several agencies and individuals who kindly supported this project. We thank Alberta Environment for financial support and the staff of Alberta Environment, D. Kupina, T.J. Spackman, G.R. Peck, and many others for providing information and data. We especially appreciate the guidance of Dr. H.S. Sandhu in establishing this research program and thank him for his continuing interest. We wish to thank E.C. Rhodes of The University of Calgary, Geography Department, for his help in data collection; J. Schaefer and N. Powell (San Jose State University) for figure preparation; W.C. Brick (San Jose State University) for trajectory analysis; and N. Meadows, A. Mann (AES), R. Angle (Alberta Environment), P. Hoff (The University of Alberta), A. Lamb (Stanley Associates Engineering Ltd.), and P. Knettig (Strathcona Industrial Association), who kindly supplied various data sets. We especially thank D.R. Connery (field work), T. Schumann (data processing), and Della Patton (report preparation) for their invaluable assistance.

1. INTRODUCTION

In order to better understand and control photochemical air pollution generated under the cold and dry climatic conditions of Alberta, an extensive program of environmental research studies was initiated in 1975 (Sandhu 1975; Bottenheim et al. 1977; Angle et al. 1979; Bottenheim and Strausz 1979, 1980; Peake and Sandhu 1983; Peake et al., 1983, 1985). One of the objectives of this program was to measure concentrations of secondary pollutants, peroxyacetyl nitrate (PAN), nitric acid, and particulate nitrate (PN) in the urban atmospheres of Alberta's two major cities, Edmonton and Calgary, and to relate these to ozone and to the primary nitrogen oxide and hydrocarbon emissions. In high concentrations, these constituents of photochemical smog can produce adverse health, ecological, and environmental effects. The results of the Calgary study, including measurements of PAN, PN, and nitric acid made in the Kananaskis Valley upwind of Calgary, were reported earlier (Peake et al. 1983). The highest PAN concentration recorded over an eight-month period in downtown Calgary was 6.0 ppb, far below the peak of 65 ppb recorded in Los Angeles, California. The mean daily maximum of 0.6 ppb PAN was similar to that of other North American cities, excluding California. Maximum daily PAN and ozone concentrations were reached simultaneously each day, usually between 1200 and 1300 h. Low intensity and duration of solar radiation restricted PAN formation in the winter months, whereas the lack of primary pollutants limited formation in the summer. Mean PAN concentrations in the Kananaskis Valley, 70 km west of Calgary, were low, about 0.1 ppb. Infrequent high values of up to 2.3 ppb were associated with forest fire smoke, indicating that PAN has natural as well as anthropogenic sources. Particulate nitrate and nitric acid concentrations in Calgary were low compared with other North American cities, but during occasional pollution episodes, high concentrations, up to 29 $\mu g/m^3$ nitrate and 41 $\mu g/m^3$ sulphate, were found. Peroxyacetyl nitrate: nitric acid:nitrate ratios indicate that PAN is the major product of NO_x reactions in the atmosphere, and that PAN may play a major role in the long-range transport of acid-forming pollutants. Present concentrations of PAN in Calgary are not likely to have major environmental or human health effects, except possibly on highly sensitive areas or individuals.

For the past decade, Alberta has undergone the highest rate of economic growth of any Canadian province and as a consequence, the major cities of Calgary and Edmonton have undergone a rapid increase in population. This rapid rate of growth has now moderated but is expected to continue at a reduced pace to the year 2000.

Despite advances in pollution control technologies, increased emission of pollutants, such as nitrogen oxides and hydrocarbons from industrial and transportation sources, are anticipated. Already concentrations of nitrogen oxides in Alberta's cities are among the highest in Canada during winter months (Alberta Environment, air monitoring annual reports 1977, 1978, 1979, 1980). In November, December, January, and February, Calgary and Edmonton have higher nitrogen oxide concentrations than Toronto and Montreal. Calgary had the highest mean nitrogen oxide concentrations for each of 14 of the 18 winter months between January 1977 and February 1981 and the second highest mean for two of the remaining months. Pollutant concentrations in Edmonton are second only to those measured in Calgary.

Public awareness and concern about air pollution in Alberta is increasing and there is a need for atmospheric research to predict future concentrations of pollutants. Predicting the concentrations of primary and secondary pollutants in the urban atmosphere of Alberta's cities is, however, a difficult task. These concentrations are influenced by the rate of emission of pollutants, by meteorological factors such as mixing height and ventilation rate, as well as by the complex atmospheric chemistry. The experience of atmospheric and environmental chemists obtained in the warmer, more humid climates of eastern Canada and much of the United States may not be directly applicable to Alberta, with its cool, dry, continental climate. Temperature, intensity, and duration of solar radiation, as well as humidity, are known to influence the rates of formation and decomposition of secondary atmospheric pollutants such as peroxyacetyl nitrate, ozone, nitric acid, and particulate nitrate.

This report focusses on (1) measurements of PAN in the Edmonton atmosphere; the relationships between PAN, ozone, and major primary pollutants; and a comparison of the concentrations of PAN and ozone in Alberta with those of other regions, (2) the concentration of PAN upwind and downwind of Edmonton and its role in the long-range transport of air pollutants, and (3) the occurrence of nitric acid (HNO_3) and particulate nitrate (NO_3^-) and sulphate in the atmosphere.

The health, ecological, and environmental effects of each form of nitrate (PAN, HNO_3, and NO_3^-) are different. Consequently, it is important to quantitatively determine the environmental distribution of these secondary pollutants generated from oxides of nitrogen and to understand what environmental conditions affect the relative concentrations (Spicer 1983).

Peroxyacetyl nitrate (PAN) and ozone are two important secondary photochemical air pollutants found in the urban atmosphere (Stephens 1969; National Research Council 1977). Of the two, PAN is the more useful indicator of photochemical reactions in polluted air because, unlike ozone, it appears to have no large natural source (Nieboer and van Ham 1976; Penkett et al. 1977; Coffey and Stasiuk 1975; Sticksel 1975). Both are strong oxidants that are phytotoxic in high concentrations and can affect human health (Taylor 1969; Taylor and MacLean 1970; National Research Council 1977). PAN is a strong eye irritant and has also been cited as a possible etiological agent in the high incidence of skin cancer observed in tropical regions as compared to temperate ones (Stephens et al. 1960; Mudd 1975; Lovelock 1977).

Previous studies of PAN have related its occurrence to primary pollutants such as nitrogen oxides and hydrocarbons (Pitts 1969; Demerjian et al. 1974; Hecht et al. 1974). The formation of PAN in the polluted atmosphere is believed to be initiated by the reaction of hydroxyl radicals with olefins or aldehydes to form peroxyacyl radicals. These radicals in turn react with nitrogen oxides to form peroxyacyl nitrates: peroxyacetyl nitrate, and lesser amounts of peroxypropionyl nitrate (Stephens 1969; Hecht et al. 1974; Lonneman et al. 1976). The concentration of PAN in the urban atmosphere is influenced not only by solar radiation but also by the magnitude of primary pollutant emissions and meteorological parameters such as temperature, mixing volumes, and ventilation rates.

Ozone measurements for Alberta cities and computer modelling of photochemical air pollution under Alberta climatic conditions have been reported previously (Bottenheim et al. 1977; Bottenheim and Strausz 1979; Environment Canada 1970 to 1981). Although theoretical calculations were available, until the Calgary study, no field observations of PAN concentrations in the Alberta atmosphere exist to validate the existing models (Sandhu 1975). In general, information of PAN concentrations for other Canadian cities and rural areas is lacking.

An important factor of PAN and ozone formation is the effect of climate. Edmonton is in the northern cool temperate zone. It is located at a latitude of 53^{o} N and an elevation of 658 m, and is 1100 km from the Pacific Ocean and 400 km east of the Continental Divide created by the Rocky Mountains. Mean daily temperature ranges from 17.4^{o}C in July to -15^{o}C in January.

Measurements of PAN have been made in European cities situated at similar northern latitudes but PAN concentrations have not been reported for cities with the cold, dry, continental climate of Alberta (Nieboer et al. 1976). The cities of Calgary and Edmonton, separated by 300 km and with no other major city within 650 km, can be considered isolated area sources of pollutants. This provides an opportunity to study PAN formation and degradation under cold, dry, climatic conditions.

Nitric oxide produced by the combustion of fossil fuels is oxidized to NO_2 in the atmosphere, and both NO and NO_2 are removed from the atmosphere by a series of chemical and physical processes. The two major pathways apear to be the converstion of NO_x to PAN, and the conversion of NO_2 to nitric acid and nitrate (Grosjean 1983), contributing to acid precipitation. Few studies have been carried out that simultaneously measure NO_x, PAN, nitric acid, and particulate nitrate, thereby enabling the relative importance of these two pathways to be assessed. None of these studies have been carried out under Alberta climatic conditions.

2. OBJECTIVES

In 1980, a research program was initiated by Alberta Environment to understand, predict, and ultimately control photochemical air pollution. Some objectives of this program are:

1. to measure the present rural and urban concentrations of peroxyacetyl nitrate, nitric acid, and particulate nitrate;
2. to establish the relationship among PAN, ozone, and major primary pollutants such as nitrogen oxides, hydrocarbons, and carbon monoxide under Alberta climatic conditions;
3. to compare PAN and ozone concentrations in Alberta with those of other regions; and
4. to identify the role of PAN in the long-range transport of air pollutants.

In addition to the above, emphasis in this study was placed on relating meteorological conditions and events to the observed pollutant concentrations, and preliminary efforts were made to understand the airflow in the boundary layer using some key surface trajectories.

3. METHODS

3.1 ANALYSIS OF PAN

The methods for the preparation of PAN analysis in the ambient atmosphere were reported in detail previously (Peake and Sandhu 1983). In principle the preparations methods were those of Stephens et al. (1965), in which PAN was prepared by the photolysis of ethyl nitrite vapour in an oxygen atmosphere. Ethyl nitrite was prepared by the reaction of ethanol, sulphuric acid, and sodium nitrite under carefully controlled conditions (Caution: the preparation of PAN and ethyl nitrite should not be attempted by those unfamiliar with the exothermic nature of the reactions and the explosive properties of the products). The concentration of PAN produced was determined from its infrared spectrum at 8.60 μ(Adamson and Gunthard 1980). Standards for calibration of the gas chromatographs were made by dilution into a known volume of dry air in a 50 L Teflon bag. The large volume of the bag and the short period, one to two minutes, between the dilation and analysis minimized any adsorption of PAN on the Teflon surfaces. No measurable reduction in PAN concentration was found over this time period.

Two gas chromatographs, a Varian 3700 and a Pye-Unicam model PU 4500 were used. Each was equipped with an electron capture detector and a 1 m by 1.5 mm glass column packed with 5% Carbowax 600 coated on Chromosorb W to achieve separation of PAN. Nitrogen was used as a carrier gas. Ambient air was sampled using an automated gas sampling system. The system consisted of a Valco gas sampling valve with air actuator and air switch, a 5 mL Teflon sample loop, a Reciprator pump, and a Valco digital valve sequence programmer. A Hewlett Packard model 3390 integrator was activated by the sequence programmer to report results. Samples were taken automatically once every 30 minutes and analysed. A chromatogram of an ambient air sample is shown in Figure 1 illustrating the separation of PAN and peroxypropionyl nitrate from the major oxygen peak. Although under ideal conditions 0.03 ppb of PAN could be detected, the overall detection limit was 0.15 ppb.

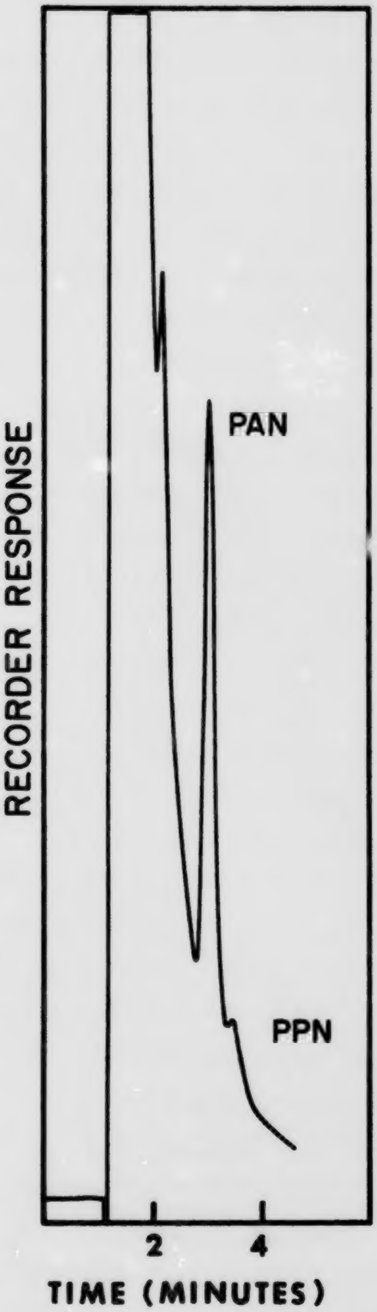


Figure 1. Gas chromatogram of an ambient air sample (0.48 ppb PAN).

3.2 SAMPLING AND ANALYSIS OF PARTICULATE NITRATE AND NITRIC ACID

3.2.1 Sample Collection

Particles and volatile nitrate (nitric acid and ammonium nitrate) were collected on a 47 mm diameter, 2.0 μg pore size Teflon filter and a 1.0 μm pore size nylon filter, respectively. The filters were mounted in an all-Teflon dual filter pack.

This stacked configuration of Teflon and nylon filters has been shown to be highly efficient for collecting particulate nitrate and nitric acid, respectively. Teflon filters are very efficient for collection of particulate nitrate with little or no conversion of nitric acid or other gaseous nitrogenous substances to nitrate (Fellin et al. 1980; Okita et al. 1976; Spicer and Schumacher 1977). Nylon filters have excellent retention of nitric acid and negligible retention of potentially interfering compounds such as NO_2 and PAN (Appel et al. 1981; Joseph and Spicer 1978; Grosjean 1983). Problems, however, may arise with the dual filter system. Ammonium nitrate, a major constituent of atmospheric particles, may be partially volatilized or decomposed after collection on the Teflon filter (Forrest et al. 1980; Appel et al. 1980; Stelson and Seinfeld 1982) with the products being collected on the nylon filter as nitric acid. This process is favored by the presence of strong acids which react with particles on the Teflon filter during sampling (Forrest et al. 1980; Harker et al. 1977; Appel and Tokiwa 1981). The amount of nitrate occurring as particulate nitrate will be underestimated and the amount of nitrate occurring as nitric acid will be overestimated. The sum of the Teflon filter-collected nitrate and the nylon filter-collected nitrate should represent the total atmospheric inorganic nitrate.

The particulate sampling system was automated with a Valco electric valve actuator, a six port valve, and a digital valve sequencer. Samples were drawn sequentially through up to six dual filter packs with the sampling time and period preset. Vacuum to draw the samples through the system was provided by a Gast model 0522-V4B-G180DX pump. The flow rate was controlled by the size of the orifices in the six port valves. These were drilled out to give a flow of 13 L/min.

3.2.2 Analysis of Filters

Teflon and nylon filters were extracted in a 10 mL precleaned polyethylene vial. The filters were extracted for 60 seconds with ultrasonic vibration with 4 mL of chromatographic eluent and allowed to stand overnight to complete the extraction. The extract was filtered through a 1 cm circle of Whatman 41 filter paper attached to a 3 mL syringe prior to analysis with a Dionex model 2020i ion chromatograph. The Whatman 41 filter paper was pre-extracted to avoid contamination.

The standard 100 µL sample loop on the ion chromatograph was replaced with a 500 µL loop in order to increase sensitivity. Anions were analysed with a 3 x 150 mm precolumn attached to an HPIC-AS4 separator column and a fibre suppressor column. The eluent was 0.0018 M sodium carbonate and 0.0021 M sodium hydroxide.

Standard solutions were made according to the directions provided by the manufacturer and used to calibrate the instrument. All filters were pre-extracted to reduce sulphate and nitrate contamination. Unused filters were analysed to provide a method blank. Teflon filters contained 0.12 µg nitrate and 1.16 µg sulphate per filter, and nylon filters 0.44 µg nitrate and 1.20 µg sulphate. These amounts corresponded to 0.006 µg NO_3^- per cubic metre and 0.062 µg SO_4 per cubic metre for the Teflon filter, and 0.024 µg per cubic metre NO_3^- and 0.064 µg per cubic metre SO_4 for the nylon filter, based on a sampling rate of 13 L/min over a 24-hour period.

3.2.3 Sampling Locations and Sampling Frequency

The main sampling location for this study was the air quality monitoring station maintained by Alberta Environment at 10255-104 Street, Edmonton (EDMU). Peroxyacetyl nitrate measurements were made at half hour intervals from 1982 December 21 to 1984 May 15 (Location 12, Figure 2). Particles and volatile nitrate (nitric acid) were collected using the dual filter pack system for one year from 1982 November 01 until 1983 October 31, on a 24-hour daily sampling basis. For the month of July 1983 the sampling frequency was increased to four six-hour periods daily.

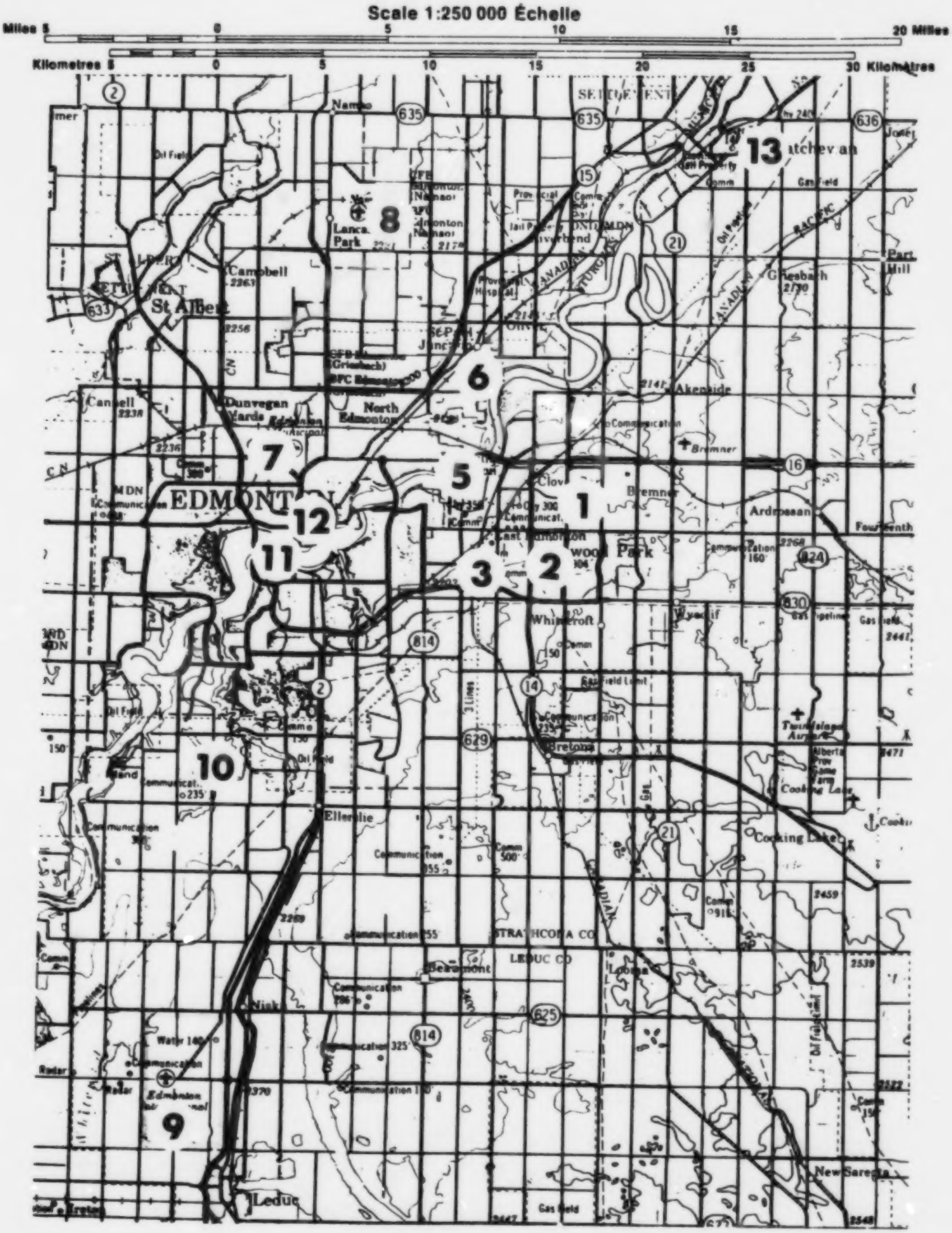

Scale 1:250 000 Échelle
Miles 5
0
5
10
15
20 Milles
Kilometres 5
0
5
10
15
20
25
30 Kilomètres
1
2
3
5
6
7
8
9
10
11
12
13
EDMONTON
St Albert
North Edmonton
Dunvegan Yards
Lanca. Park
Campbell
Namao
Akenside
Bremner
Clover Bar
Ardrossan
East Edmonton
Whitecroft
Wye Clif
Bretona
Ellerslie
Nisku
Beaumont
Leduc
New Sarepta
Cooking Lake
STRATHCONA CO
LEDUC CO
Edmonton International
635
636
633
15
21
16
824
830
814
14
629
625
2

Figure 2. Map of Edmonton study area showing location of wind monitoring sites.

A second sampling site was located at Alberta Environment's monitoring station at Ellerslie, about 2 km south of the sprawling urban development of Edmonton (Location 10, Figure 2). This site was originally chosen for an air monitoring station because winds are commonly from the southeast, therefore it is upwind of Edmonton. PAN measurements were made and filter samples were collected, from 1983 July 13 to 1983 August 11. The filter collection periods were six hours.

The third location was Alberta Environment's air quality monitoring station at 9922-104 Street in downtown Fort Saskatchewan (Location 13, Figure 2). This station is often downwind of Edmonton and is about 12 km from the industrial eastern outskirts of Edmonton. In addition a number of petrochemical-based industries are located near the town and to the east of Fort Saskatchewan. Peroxyacetyl nitrate measurements were made from 1983 August 17 to 1983 September 16, and from 1984 April 17 to 1984 May 05. Filter samples were taken during the 1983 sampling period.

3.3 METEOROLOGICAL STUDIES

3.3.1 Objectives

The objectives of the meteorological component of the study were: (1) to provide documentation of meteorological conditions that existed during selected PAN episodes, and (2) given available data, to determine the contributions of meteorological processes to the temporal and spatial characteristics of elevated PAN concentrations.

3.3.2 Case Selection

PAN events were identified for individual case studies in a two-step process. Preliminary selections were made according to PAN concentration and duration. Final case selections were made as a function of preliminary meteorological analyses and relative episode concentrations and durations.

For discussion purposes, the term "case" refers to one or more days on which significant PAN "episodes" occur. An episode is a period of usually less than 24 hours during which PAN concentrations continuously exceed a given threshold.

3.3.3 Meteorological Data Acquisition

Meteorological data and analyses were acquired from the Atmospheric Environment Service (AES), Edmonton and Calgary, the Air Control Branch of Alberta Environment (AE), the Strathcona Industrial Association (SIA), and the Division of Meteorology of The University of Alberta (UA). Data types and sources versus location are listed in Table 1. Stations shown in Figure 2, with the exception of 4 and 12, were used in trajectory computations.

Acquired data also included analysed surface, 850 mb, 700 mb, and 500 mb weather charts from AES. The surface maps were available at 3- or 6-hour intervals, while the upper air charts were available every 12 hours. For each case study, hourly surface observations from International (YEG), Industrial (YXD), and Namao (YED) have been plotted in a simplified format for reference purposes. The station plotting model is described in Table 2.

3.3.4 Meteorological Data Analysis

Synoptic analyses, as well as hourly weather observations from YEG, YXD, and YED airports, were used to document the broad-scale surface and upper air flow patterns and the stability regimes. Winds from Tory Tower, at 63 m, were also used to diagnose the broad-scale wind regime and its local and synoptic time changes for cases 1 to 6. Maximum mixing depths were estimated from the Stony Plain Rawinsonde.

Final episode analysis included backward trajectories from the PAN observation site (EDMU: Site 12) based on hourly wind data from the previously described surface stations (Table 1 and Figure 2). The primary trajectory for each case terminated at EDMU at the time of the PAN maximum for the given episode. In cases where distinct secondary peaks occurred in the PAN record, secondary trajectories were also computed to terminate at Edmonton EDMU at those times. In the present report, secondary trajectories are only presented in those cases where there was a significant variation from the primary trajectory.[1]

---

[1] In cases 7 and 8, trajectories terminated at two PAN measurement sites (EDMU and Ft. Saskatchewan).

Table 1. Sources of meteorological data.

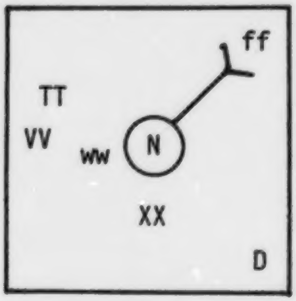
Station		Data Type[a]								
Number	Name	C	Wx	VS	P	T	D	V	Other	Source
1	Clover Bar							x		SIA
2	Sherwood Park							x		SIA
3	Elmjay							x		SIA
5	Beverly							x		SIA
6	Clareview							x		SIA
7	Municipal Airport	x	x	x	x	x	x	x		AES
8	Namao	x	x	x	x	x	x	x		AES
9	International Airport	x	x	x	x	x	x	x		AES
10	Ellerslie				x	x		x	also radiation, turbulence parameters, SODAR low level winds, air quality data	AE
11	Tory Tower Univ. of Alberta							x	63 m	UA
12	EDMU								Air quality data	AE
13	Fort Saskatchewan								Air quality data	AE
	Stony Plain								Radiosonde at 0500 and 1700 MST	AES
14	Argyle Centre								Pilot balloon low level winds at 1100 and 2300 MST	AES

[a] Surface Observations:

C Cloud height, amount, and type
Wx Weather and obstructions to vision
VS Visibility
P Pressure
T Temperature
D Dewpoint
V Wind Velocity (hourly averages except one-minute averages at YED, YXD, YEG).

Table 2. Sample station plotting model and plotting symbols key.

Station Model



Explanation of Symbols

/	Indicates direction *from* which the wind blows
⌊ff	Windspeed (km/h)
D	Tens digit of wind direction
TT	Temperature (°C)
VV	Visibility (km)

Symbols Used to Describe Sky Cover (N)

○	Clear	⦶	Scattered (1 to 5 tenths)
⦷	Broken	⊕	Overcast (10 tenths)
⊗	Sky obscured by ground-based phenomena		
XX	Amount of sky obscured (tenths)		

Symbols Used to Describe Weather and Obstructions (ww)

•	Rain	$\dot{☈}$	Thunderstorm with rain
=	Fog	☈	Thunderstorm with no rain
$\dot{\nabla}$	Rainstorm	∿	Smoke
,	Drizzle	∞	Haze

Trajectory computations were based on an algorithm described by Kokin et al. (1973). The program handles up to 32 wind stations over a 200 x 200 km grid in the calculation of forward or backward trajectories. Wind information at each successive air parcel position is interpolated on the basis of all reported winds, each report weighted as the inverse square of the distance from the parcel location. The trajectory algorithm was tested with a data set for a known trajectory. Also, a few manual trajectories from the current study were computed for comparison. Agreement was very good.

It is important to note that the greatest density of wind data is in and around the city of Edmonton. A trajectory constructed some distance from Edmonton was, therefore, based on extrapolated winds. The use of winds from Rocky Mountain House, Red Deer, Coronation, and other areas was possible, but interpolation of what were frequently very light winds over great distances was considered inadvisable. Therefore, trajectory computations were usually terminated 12 to 24 hours upstream or within about 100 km of Edmonton, except where noted. Despite the relatively dense wind data network around Edmonton, the spacing between stations was such that the terrain was best treated as flat. Thus, the trajectory computations only reflect the terrain effects indirectly in terms of the reported winds. Efforts were made to isolate the responses of circulations (and thus trajectories) to local-scale topographic influences such as the North Saskatchewan River Valley. However, this was a subjective procedure, based mainly on known terrain characteristics and on previous studies (e.g., Paterson 1978).

4. RESULTS AND DISCUSSION

4.1 PAN CONCENTRATIONS IN THE EDMONTON ATMOSPHERE

Full results from measurements of PAN in Edmonton, Ellerslie, and Fort Saskatchewan are contained in appendices 9.1 and 9.2. Summaries of the Edmonton data are contained in tables 3 and 4. Ellerslie results are presented in Table 7.

Some 18 500 PAN measurements were made in downtown Edmonton during the period 1982 December 21 to 1984 May 13, thus measurements were obtained 81% of the time. The remaining 19% of the measurements were lost due to instrument malfunction and time taken to calibrate the instrument. In view of the experimental nature of the PAN monitoring instrument and the fact that it was operated at a location remote from our Calgary laboratories, the percentage data recovery was high.

The mean PAN concentration during the period 1982 December 21 to 1984 February 28 was 0.24 ppb. This mean value is at best only an approximation because 4529 of the 15 881 readings were below the detection limit of 0.15 ppb. These were assigned a value of 0.075 ppb, one-half of the detection limit. This greatly influences the monthly mean values when a high percentage of the data is below the detection limit, which usually occurs in the winter months, i.e., December 1982 (Table 4). In the spring and summer, the number of readings below the detection limit was low, only 3.9% in April 1983, and the means accurately reflect the true PAN concentrations. The mean of the daily maxima for 400 days when the maximum PAN concentration was above the detection limit was 0.57 ppb and the maximum concentration over the 17-month period was 7.5 ppb (Table 3).

These concentrations are comparable to those found in the previous study of the Calgary atmosphere (Peake and Sandhu 1983). The mean concentration of PAN at the downtown Calgary location was 0.14 ppb and the mean of the daily maxima was 0.59 ppb. Maximum PAN concentrations recorded at the two Calgary sampling locations were 2.4 ppb at the University of Calgary and 6.6 ppb at the downtown Calgary sampling location.

Table 3. Weekly means and maxima of atmospheric concentrations of PAN at the downtown Edmonton site, January 1983 to May 1984.

	Means[a]	Maxima	Max. Date
Jan 02, 1983	0.12 (n=122)	0.24	1983 Jan 08
Jan 09	0.11 (n=135)	0.52	1983 Jan 14
Jan 16	(n=1)		
Jan 23	(n=0)		
Jan 30	0.29 (n=237)	0.55	1983 Feb 01
Feb 06	0.49 (n-251)	0.91	1983 Feb 06
Feb 13	0.17 (n=255)	0.58	1983 Feb 19
Feb 20	0.18 (n=135)	0.84	1983 Feb 20
Feb 27	0.29 (n=265)	0.57	1983 Mar 03
Mar 06	0.29 (n=267)	0.65	1983 Mar 12
Mar 13	0.23 (n=317)	0.47	1983 Mar 19
Mar 20	0.56 (n=336)	1.12	1983 Mar 26
Mar 27	0.32 (n=334)	0.88	1983 Mar 31
Apr 03	0.26 (n=336)	0.64	1983 Apr 04
Apr 10	0.28 (n=336)	0.59	1983 Apr 15
Apr 17	0.34 (n=328)	0.77	1983 Apr 23
Apr 24	0.33 (n=274)	1.24	1983 Apr 28
May 01	0.29 (n=272)	0.69	(Multi-date)
May 08	0.31 (n=220)	0.77	1983 May 12
May 15	0.15 (n=228)	0.29	1983 May 17
May 22	0.30 (n=304)	1.22	1983 May 28
May 29	0.33 (n=116)	0.94	1983 May 29
Jun 05	(n=0)		
Jun 12	0.62 (n=117)	2.99	1983 Jun 16
Jun 19	0.26 (n-261)	0.92	1983 Jun 24
Jun 26	0.49 (n-280)	2.43	1983 Jun 28
Jul 03	0.47 (n-269)	1.21	1983 Jul 05
Jul 10	0.26 (n-326)	0.83	1983 Jul 11
Jul 17	0.40 (n=333)	1.66	1983 Jul 19
Jul 24	0.29 (n=327)	3.47	1983 Jul 25
Jul 31	0.48 (n=290)	3.50	1983 Aug 02
Aug 07	0.46 (n=273)	2.32	1983 Aug 13
Aug 14	0.32 (n=336)	1.27	1983 Aug 15
Aug 21	0.59 (n=287)	7.51	1983 Aug 23
Aug 28	0.63 (n=179)	4.13	1983 Aug 30

continued...

Table 3. Concluded.

	Means[a]	Maxima	Max. Date
Sep 04	0.24 (n=164)	0.63	1983 Sep 08
Sep 11	0.25 (n=212)	0.72	1983 Sep 15
Sep 18	0.20 (n=335)	1.00	1983 Sep 24
Sep 25	0.25 (n=216)	0.88	1983 Sep 26
Oct 02	0.21 (n=232)	0.71	1983 Oct 08
Oct 09	0.25 (n=254)	0.86	1983 Oct 11
Oct 16	0.30 (n=261)	1.23	1983 Oct 20
Oct 23	0.20 (n=168)	0.96	1983 Oct 29
Oct 30	0.16 (n=300)	0.45	1983 Oct 30
Nov 06	0.14 (n=226)	0.70	1983 Nov 12
Nov 13	0.14 (n=245)	0.65	1983 Nov 13
Nov 20	0.11 (n=263)	0.26	1983 Nov 26
Nov 27	0.12 (n=238)	0.28	1983 Nov 30
Dec 04	0.12 (n=287)	0.53	1983 Dec 04
Dec 11	0.17 (n=292)	0.33	1983 Dec 11
Dec 18	0.11 (n=336)	0.27	1983 Dec 18
Dec 25	0.09 (n=256)	0.20	(Multi-date)
Jan 01, 1984	0.09 (n=210)	0.21	1984 Jan 07
Jan 08	0.12 (n=335)	0.52	1984 Jan 14
Jan 15	0.12 (n=307)	0.22	(Multi-date)
Jan 22	0.12 (n=247)	0.24	1984 Jan 26
Jan 29	0.13 (n=331)	0.25	(Multi-date)
Feb 05	0.20 (n=331)	0.54	1984 Feb 06
Feb 12	0.20 (n=335)	0.46	1984 Feb 13
Feb 19	0.18 (n=326)	0.46	1984 Feb 24
Feb 26	0.18 (n=334)	0.66	1984 Feb 28
Mar 04	0.20 (n=276)	0.37	1984 Mar 09
Mar 11	0.41 (n=22)	0.93	1984 Mar 15
Mar 18	0.28 (n=79)	0.57	1984 Mar 20
Mar 25	(n=0)		
Apr 01	0.53 (n=252)	1.24	1984 Apr 06
Apr 08	0.50 (n=330)	1.03	1984 Apr 10
Apr 15	0.44 (n=332)	1.70	1984 Apr 16
Apr 22	0.46 (n=302)	2.29	1984 Apr 27
Apr 29	0.67 (n=197)	1.15	1984 May 04
May 06	0.46 (n=275)	1.10	1984 May 08

[a] (n) = number of observations

Table 4. The percentile distribution maximum reading of PAN measurements made in downtown Edmonton 1982 December 21 to 1983 May 14.

Range (ppb)	Number of Readings	Percentile
1982 December		
<0.15 to	205	91.52
0.15 to 0.50	19	8.48
0.51 to 1.00	0	0.00
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 224
Maximum Reading = 0.24 ppb
Average Reading = 0.08 ppb

1983 January

<0.15	684	53.48
0.15 to 0.50	551	43.08
0.51 to 1.00	33	2.58
1.01 to 1.50	1	0.08
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00		

Total number of readings = 1279
Maximum Reading = 1.04 ppb
Average Reading = 0.16 ppb

continued...

Table 4. Continued.

Range (ppb)	Number of Readings	Percentile
1983 February		
<0.15	242	26.71
0.15 to 0.50	543	59.93
0.51 to 1.00	121	13.36
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00		

Total number of readings = 906
Maximum Reading = 0.91 ppb
Average Reading = 0.27 ppb

Range (ppb)	Number of Readings	Percentile
1983 March		
<0.15	136	9.74
0.15 to 0.50	933	66.83
0.51 to 1.00	318	22.78
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00		

Total number of readings = 1396
Maximum Reading = 1.12 ppb
Average Reading = 0.38 ppb

continued...

Table 4. Continued.

Range (ppb)	Number of Readings	Percentile
1983 April		
<0.15	53	3.87
0.15 to 0.50	1208	88.18
0.51 to 1.00	105	7.66
1.01 to 1.50	4	0.29
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00		
Total number of readings = 1370		
Maximum Reading = 1.24 ppb		
Average Reading = 0.30 ppb		
1983 May		
<0.15	172	15.11
0.15 to 0.50	870	76.45
0.51 to 1.00	95	8.35
1.01 to 1.50	1	0.09
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00		
Total number of readings = 1138		
Maximum Reading = 1.22 ppb		
Average Reading = 0.28 ppb		

continued...

Table 4. Continued.

Range (ppb)	Number of Readings	Percentile
1983 June		
<0.15	124	20.03
0.15 to 0.50	331	53.47
0.51 to 1.00	129	20.84
1.01 to 1.50	19	3.07
1.51 to 2.00	11	1.78
2.01 to 3.00	0	0.81
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 619
Maximum Reading = 2.99 ppb
Average Reading = 0.40 ppb

Range (ppb)	Number of Readings	Percentile
1983 July		
<0.15	230	17.11
0.15 to 0.50	835	62.13
0.51 to 1.00	253	18.82
1.01 to 1.50	19	1.41
1.51 to 2.00	4	0.30
2.01 to 3.00	2	0.15
3.01 to 5.00	1	0.07
>5.00	0	0.00

Total number of readings = 1344
Maximum Reading = 3.47 ppb
Average Reading = 0.35 ppb

continued...

Table 4. Continued.

Range (ppb)	Number of Readings	Percentile
1983 August		
<0.15	175	13.82
0.15 to 0.50	641	50.63
0.51 to 1.00	320	25.28
1.01 to 1.50	79	6.24
1.51 to 2.00	32	2.53
2.01 to 3.00	12	0.95
3.01 to 5.00	6	0.47
>5.00	1	0.08

Total number of readings = 1266
Maximum Reading = 7.51 ppb
Average Reading = 0.51 ppb

Range (ppb)	Number of Readings	Percentile
1983 September		
<0.15	341	34.62
0.15 to 0.50	564	57.26
0.51 to 1.00	76	7.72
1.01 to 1.50	4	0.41
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 985
Maximum Reading = 1.24 ppb
Average Reading = 0.24 ppb

continued...

Table 4. Continued.

Range (ppb)	Number of Readings	Percentile
1983 October		
<0.15	333	32.91
0.15 to 0.50	589	58.20
0.51 to 1.00	87	8.60
1.01 to 1.50	3	0.30
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 1012
Maximum Reading = 1.23 ppb
Average Reading = 0.26 ppb

Range (ppb)	Number of Readings	Percentile
1983 November		
<0.15	600	57.36
0.15 to 0.50	427	40.82
0.51 to 1.00	19	1.82
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 1046
Maximum Reading = 0.70 ppb
Average Reading = 0.14 ppb

continued...

Table 4. Continued.

Range (ppb)	Number of Readings	Percentile
1983 December		
<0.15	679	52.15
0.15 to 0.50	622	47.77
0.51 to 1.00	1	0.08
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 1302
Maximum Reading = 0.53 ppb
Average Reading = 0.13 ppb

Range (ppb)	Number of Readings	Percentile
1984 January		
<0.15	709	57.13
0.15 to 0.50	531	42.79
0.51 to 1.00	1	0.08
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 1241
Maximum Reading = 0.52 ppb
Average Reading = 0.12 ppb

continued...

Table 4. Continued.

1984 February

Range (ppb)	Number of Readings	Percentile
<0.15	290	21.14
0.15 to 0.50	1077	78.50
0.51 to 1.00	5	0.36
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 1372
Maximum Reading = 0.66 ppb
Average Reading = 0.19 ppb

1984 March

Range (ppb)	Number of Readings	Percentile
<0.15	106	14.72
0.15 to 0.50	565	78.47
0.51 to 1.00	49	6.81
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00

Total number of readings = 720
Maximum Reading = 0.93 ppb
Average Reading = 0.26 ppb

continued...

Table 4. Concluded.

Range (ppb)	Number of Readings	Percentile
1984 April		
<0.15	18	1.47
0.15 to 0.50	733	59.84
0.51 to 1.00	437	35.67
1.01 to 1.50	21	1.71
1.51 to 2.00	13	1.06
2.01 to 3.00	3	0.24
3.01 to 5.00	0	0.00
>5.00	0	0.00
Total number of readings = 1225		
Maximum Reading = 2.29 ppb		
Average Reading = 0.49 ppb		
1984 May		
<0.15	0	0.00
0.15 to 0.50	226	56.50
0.51 to 1.00	169	42.25
1.01 to 1.50	5	1.25
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
>5.00	0	0.00
Total number of readings = 400		
Maximum Reading = 1.15 ppb		
Average Reading = 0.52 ppb		

Most previous studies of PAN in the urban atmosphere have been carried out over shorter time periods, generally a few weeks (tables 5 and 6). During the summer months in Houston, Texas, mean daytime PAN concentrations of about 1.0 ppb with a maximum of 15.6 ppb were recorded (Jorgen 1978). For a one-month period from mid-July to mid-August 1973, Spicer (1974) reported an average of 1.8 ppb in St. Louis, Missouri, with a daily maxima averaging 4.6 ppb and a maximum of 19 ppb. By comparison, the August 1983 mean for downtown Edmonton was 0.51 ppb, the mean daily maximum was 1.48 ppb, and the maximum recorded was 7.51 ppb. Edmonton's atmospheric concentrations of PAN are similar to those reported for northern European cities: Riso, Denmark; Goteberg, Sweden; Delft, Netherlands; Essen, West Germany; and Harwell, England (Table 6). They are far lower than levels measured in the Los Angeles basin where long-term studies have been carried out. The yearly average at Riverside, California for 1980 during the hours of 0800 and 2000 was 4.9 ppb, and the highest concentration recorded was 41.6 ppb (Temple and Taylor 1983).

4.2 PAN CONCENTRATIONS AT ELLERSLIE

PAN measurements were made at Ellerslie, about 2 km south of Edmonton suburban development, from 1983 July 13 to August 11. Some 964 measurements were made during this period, of which 666 fell below the 0.35 ppb detection limit for the Varian gas chromatograph at that time (Table 7). The maximum reading was 1.30 ppb obtained on August 3 and the mean was 0.25 ppb when a value of 0.175 ppb was assigned to measurements below the detection limit of 0.35 ppb. The mean of the highest daily readings for the 18 days when PAN concentrations were above the detection limit was 0.53 ppb. During the same 1983 July 13 to August 11 period in Edmonton, the mean of the daily maxima was 1.02 ppb and the highest value recorded was 3.50 ppb. The differences in the mean PAN concentrations between the two sites is a reflection of the location of the Ellerslie monitoring station, which is usually upwind of Edmonton. The high reading at Ellerslie of 1.30 ppb obtained on August 3 was of interest as it exceeded the high value of 0.92 ppb reached in Edmonton that day. Winds were northerly and northeasterly prior to the PAN maxima, placing Ellerslie in the urban plume from

Table 5. Summary of ambient PAN monitoring in North America.[a] All data in parts per billion (ppb).

City	Sampling Period	Monthly Average	Daily Mean	Maximum Observation	Reference
East and Mid-West					
Simcoe, ON	1980 Jun to Dec	<2		5.6	Corkum et al. 1982
Hoboken, NJ	1980 Jun to Aug (1000 to 1600 h)	3.7		9.9	Lonneman et al. 1976
New Brunswick, NJ	1978 Sep 30 to Dec 08 (0800 to 1800 h)	0.5	1.2	10.6	Lewis et al. 1983
Downington, PA	1979 Aug 16 to Sep 20	<1	2.2	5.0	Westberg et al. 1978
Wilmington OH	1974 Aug		2.0	4.1	Lonneman et al. 1976
St. Louis, MO	1973 Jun to Aug (1000 to 1600 h)	6.3		25	Lonneman et al. 1976
St. Louis, MO	1973 Jul 18 to Aug 16	1.8	4.6	19	Spicer 1974
Houston, TX	1976 Jul 02 to 23 (1000 to 1600 h)	1.0		11.5	Jorgen 1978
Houston, TX	1977 Jun 01 to Oct 31	0.6		15.6	Temple and Taylor 1983
West					
Calgary, AB residential	1980 Dec 01 1981 Aug 31 (0900 to 1600 h)	0.2	0.4	2.4	Peake and Sandhu 1983
Calgary, AB downtown	1981 Jul 12 1982 Feb 28	0.1	0.6	6.6	Peake and Sandhu 1983

continued...

Table 5. Concluded.

City	Sampling Period	Monthly Average	Daily Mean	Maximum Observation	Reference
West (continued)					
Salt Lake City, UT			10 to 20	54	Tingey and Hill 1968
Los Angeles, CA	1965 Sep 1965 Oct	38 60		210	Mayrsohn and Brooks 1965
Los Angeles, CA	1968 Sep to Nov (1000 to 1600 h)		10 to 30	65.5	Lonneman et al. 1976
West Covina, CA	1973 Aug 24 to Sep 28	8.8	22.4	46	Spicer 1974
Riverside, CA	1967 Aug to Apr (0800 to 1800 h)	4.6		58	Taylor 1969
Riverside, CA	1980 Jan to Dec (0800 to 2000 h)	4.9	25.1	41.6	Temple and Taylor 1983
Point Arena, CA	1982 Aug 25 to Aug 29	0.03		0.12	Singh and Salas 1983
Pacific Ocean troposphere	1982 Sep 8 to Sep 14	0.08		0.40	Singh and Salas 1983

[a] After Temple and Taylor 1983.

Table 6. Summary of world-wide measurements of ambient PAN concentrations (exluding North America).[a] All data in parts per billion (ppb).

City and Country	Sampling Period	Daily Average	Monthly Mean	Daily Max.	Max. Observation	Reference
Riso, Denmark	1980 Jun 11 to Sep 23			0.9	4.2	Nielsen et al. 1981
Goteborg, Sweden	1980 Jun 9 to Sep 9			0.8	3.5	Nielsen et al. 1981
Delft, Netherlands	1973 Jun to 1972 Nov	0.6		1.4	16	Bos et al. 1977
Delft, Netherlands	1973 Jun to 1973 Oct	<2			ca.20	Guicherit 1976
Essen, W. Germany	1978 Jun to 1978 Sep	<1	1		3.6	Bruckmann and Eynck 1979
Harwell, England	1974 Nov to 1975 Oct	<1	0.27		8.9	Penkett et al. 1977
Harwell, England	1980 Jan to 1981 Jun		0.5		5.2	Brice et al. 1984
London, England	1975 Aug to 1975 Oct				16.1	Penkett et al. 1977
Central Tokyo, Japan	1973 Jun 13 to Jul 13				31.2	Izumikawa et al. 1975
Suburban Tokyo, Japan	1972 Jul 01 to Aug 31			to	8.2	Izumikawa et al. 1975
Near Ohme, Japan	1973 Jun 13 to Jul 06				13.5	Bruckmann and Eynck 1979
Tokyo, Japan	1972 Sep 20 to Nov 30			ca. 5	6.7	Fukuda and Terakado 1974

[a] After Temple and Taylor 1983.

Table 7. PAN in the Ellerslie atmosphere, July and August 1983 (ppb).

July	9	10	11	12	13	14	15	16
Time								
0030						<0.35	<0.35	<0.35
0100						<0.35	<0.35	<0.35
0130						<0.35	<0.35	<0.35
0200						<0.35	<0.35	<0.35
0230						<0.35	<0.35	<0.35
0300						<0.35	<0.35	<0.35
0330						<0.35	<0.35	<0.35
0400						<0.35	<0.35	<0.35
0430						<0.35	<0.35	<0.35
0500						<0.35	<0.35	<0.35
0530						<0.35	<0.35	<0.35
0600						<0.35	<0.35	<0.35
0630						<0.35	<0.35	<0.35
0700						<0.35	<0.35	<0.35
0730						<0.35	<0.35	<0.35
0800					0.35	<0.35	<0.35	<0.35
0830						<0.35	<0.35	<0.35
0900						<0.35	<0.35	<0.35
0930						<0.35	<0.35	<0.35
1000						<0.35	<0.35	<0.35
1030						<0.35	<0.35	<0.35
1100						<0.35	<0.35	<0.35
1130						<0.35		<0.35
1200						<0.35		<0.35
1230						<0.35		<0.35
1300					0.35	<0.35		<0.35
1330					0.35	<0.35		<0.35
1400					0.40	<0.35	<0.35	<0.35
1430					0.60	<0.35	<0.35	<0.35
1500					0.35	<0.35	<0.35	<0.35
1530						<0.35	0.35	<0.35
1600					0.35	<0.35	<0.35	<0.35
1630					0.40	<0.35	<0.35	<0.35
1700					0.35	<0.35	<0.35	<0.35
1730					0.35	<0.35	<0.35	<0.35
1800					<0.35	<0.35	<0.35	<0.35
1830					<0.35	<0.35	<0.35	<0.35
1900					<0.35	<0.35	<0.35	<0.35
1930					<0.35	<0.35	<0.35	<0.35
2000					0.35	<0.35	<0.35	<0.35
2030					<0.35	<0.35	<0.35	<0.35
2100					<0.35	<0.35	<0.35	<0.35
2130					<0.35	<0.35	<0.35	<0.35
2200					<0.35	<0.35	<0.35	<0.35
2230					<0.35	<0.35	<0.35	<0.35
2300					<0.35	<0.35	<0.35	<0.35
2330					<0.35	<0.35	<0.35	<0.35
2400					<0.35	<0.35	<0.35	<0.35

continued...

Table 7. Continued.

July	17	18	19	20	21	22	23	24
Time								
0030	<0.35	<0.35	<0.35	<0.35				
0100	0.35	<0.35	0.35	<0.35				
0130	<0.35	<0.35	0.35	<0.35				
0200	<0.35	<0.35	0.35	<0.35				
0230	<0.35	<0.35	0.35	<0.35				
0300	<0.35	0.35	0.35	<0.35				
0330	<0.35	<0.35	0.35	<0.35				
0400	<0.35	0.35	0.35	<0.35				
0430	<0.35	<0.35	<0.35	<0.35				
0500	<0.35	0.35	<0.35	<0.35				
0530	<0.35	<0.35	<0.35	<0.35				
0600	<0.35	<0.35	<0.35	<0.35				
0630	<0.35	<0.35	<0.35	<0.35				
0700	<0.35	<0.35	<0.35	<0.35				
0730	<0.35	<0.35	0.35	<0.35				
0800	<0.35	<0.35	0.35	<0.35				
0830	<0.35	<0.35	0.35	<0.35				
0900	<0.35	<0.35	0.40	<0.35				
0930	<0.35	<0.35	0.40	<0.35	<0.35			
1000	<0.35	<0.35	0.40	<0.35	<0.35			
1030	<0.35	<0.35	0.44	<0.35	<0.35			
1100	<0.35	<0.35		<0.35	<0.35			
1130	<0.35	0.35		<0.35	<0.35	0.35		
1200	<0.35	0.35		0.35	<0.35	0.35		
1230	<0.35	0.35		0.35	<0.35	0.35		
1300	<0.35	0.40		0.35	<0.35	0.35		
1330	<0.35	0.41		0.35	<0.35			
1400	<0.35	0.44		0.35	<0.35	0.40		
1430	<0.35	0.40		<0.35	<0.35	0.35		
1500	<0.35	0.40		<0.35	<0.35	0.37		
1530	<0.35	0.35		<0.35	<0.35	0.35		
1600	<0.35	0.35		<0.35	<0.35	<0.35		
1630	<0.35	0.35		<0.35	<0.35	0.35		
1700	<0.35	0.35	0.35	<0.35	<0.35	0.37		
1730	<0.35	0.35	0.35	<0.35	<0.35	<0.35		
1800	<0.35	<0.35	0.35		<0.35	0.35		
1830	<0.35	<0.35	<0.35		<0.35	<0.35		
1900	<0.35	<0.35	<0.35		<0.35	<0.35		
1930	<0.35	0.35	<0.35		<0.35	<0.35		
2000	<0.35		<0.35	<0.35	<0.35	0.35		
2030	<0.35	<0.35	<0.35	<0.35		<0.35		
2100	<0.35	<0.35	<0.35	<0.35		<0.35		
2130	<0.35	<0.35	<0.35	<0.35		<0.35		
2200	<0.35	<0.35	<0.35	<0.35		<0.35		
2230	<0.35	<0.35	<0.35	<0.35		<0.35		
2300	<0.35	<0.35	<0.35	<0.35		<0.35		
2330	<0.35	<0.35	<0.35	<0.35		<0.35		
2400	<0.35	<0.35	<0.35					

continued...

Table 7. Continued.

July	25	26	27	28	29	30	31
Time							
0030		<0.35	<0.35	<0.35	<0.35	<0.35	0.35
0100		<0.35	<0.35	<0.35	<0.35	<0.35	<0.35
0130		<0.35	<0.35	<0.35	<0.35	<0.35	<0.35
0200		<0.35	<0.35		<0.35	<0.35	<0.35
0230		<0.35	<0.35		<0.35	<0.35	<0.35
0300		<0.35	<0.35		<0.35	<0.35	<0.35
0330			<0.35		<0.35		<0.35
0400			<0.35		<0.35		<0.35
0430			<0.35		<0.35		<0.35
0500			<0.35				<0.35
0530			<0.35				<0.35
0600			<0.35				<0.35
0630			<0.35				<0.35
0700			<0.35				<0.35
0730			<0.35	<0.35			<0.35
0800			<0.35	<0.35			<0.35
0830			<0.35	<0.35			<0.35
0900			<0.35	<0.35			<0.35
0930			<0.35	<0.35	<0.35		<0.35
1000			<0.35	<0.35	<0.35		0.35
1030			<0.35	<0.35	0.35		0.35
1100		<0.35	<0.35	<0.35	0.35		0.35
1130	<0.35	<0.35	<0.35	0.35	0.35		0.35
1200	<0.35	<0.35	<0.35	0.35	0.35	0.35	0.35
1230	0.35	<0.35		0.35	0.35	0.35	0.35
1300	0.37	<0.35	<0.35	0.35	0.35	0.35	0.35
1330	0.40	<0.35	<0.35	0.35	0.35	0.40	0.35
1400	0.40	<0.35	<0.35	0.35	0.35	0.40	0.37
1430	0.40	<0.35	<0.35	0.35	0.35	0.40	0.35
1500	0.40		<0.35	0.35	0.35	0.42	0.35
1530	0.41		<0.35	0.35	0.35	0.42	0.35
1600	0.44			0.35	0.35	0.44	0.35
1630	0.44	<0.35	<0.35	0.35	0.35	0.44	0.35
1700	0.44	<0.35		0.35	<0.35	0.35	0.35
1730		<0.35	<0.35	0.35	0.35	0.35	0.35
1800		<0.35	<0.35	<0.35	0.35	0.35	<0.35
1830	0.35	<0.35	<0.35	<0.35	<0.35	0.35	<0.35
1900	0.35	<0.35		<0.35	0.35	0.35	
1930	<0.35	<0.35		0.45	0.35	0.37	
2000	<0.35	<0.35		0.45	0.35	0.35	
2030	<0.35	<0.35		<0.35	0.35	0.35	
2100	<0.35	<0.35	<0.35	<0.35	0.35	0.35	
2130	<0.35	<0.35	<0.35	<0.35	0.35	0.35	
2200	<0.35	<0.35	<0.35	<0.35	<0.35	0.35	
2230	<0.35	<0.35	<0.35	<0.35	<0.35	0.35	
2300	<0.35	<0.35	<0.35	<0.35	<0.35	0.35	
2330	<0.35	<0.35	<0.35	<0.35	<0.35	0.35	
2400	<0.35	<0.35	<0.35	<0.35	<0.35	0.35	

continued...

Table 7. Continued.

August	1	2	3	4	5	6	7	8
Time								
0030			<0.35		<0.35	<0.35	<0.35	0.49
0100			<0.35		<0.35	<0.35	<0.35	0.53
0130			<0.35		<0.35	<0.35	<0.35	0.45
0200			<0.35		<0.35	<0.35	<0.35	0.35
0230			<0.35		<0.35	<0.35	<0.35	<0.35
0300			<0.35		<0.35	<0.35	<0.35	<0.35
0330			<0.35		<0.35	<0.35	<0.35	<0.35
0400			<0.35		<0.35	<0.35	<0.35	<0.35
0430			<0.35		<0.35	<0.35		<0.35
0500			<0.35		<0.35	<0.35		<0.35
0530			<0.35		<0.35	<0.35		<0.35
0600			<0.35		<0.35	<0.35		<0.35
0630			<0.35		<0.35	<0.35		<0.35
0700			<0.35		<0.35	<0.35		<0.35
0730			0.35		<0.35	<0.35		<0.35
0800			<0.35		<0.35	<0.35		<0.35
0830			<0.35		0.50	<0.35	<0.35	<0.35
0900			<0.35		0.60	<0.35	<0.35	<0.35
0930			<0.35		0.70	<0.35	<0.35	<0.35
1000		0.60	0.35		0.75	<0.35	<0.35	<0.35
1030		0.80	0.37	0.35	0.75	<0.35	<0.35	<0.35
1100		0.70	0.40	0.35	0.75	<0.35	<0.35	0.40
1130		0.85	0.45	<0.35	0.76	<0.35	<0.35	0.42
1200		0.85	0.60	<0.35	0.78	<0.35	<0.35	0.42
1230		0.85	0.69	0.40	0.70	<0.35	<0.35	0.46
1300		0.85	0.80	0.50	0.60	0.35	<0.35	0.50
1330		0.80	0.85	0.40	0.65	0.35	<0.35	0.70
1400		0.40	1.00	0.35	0.70	0.35	<0.35	0.65
1430		0.35	0.95	0.35	0.60	0.35	0.35	0.62
1500		0.35	1.30	0.35	0.50	0.35	0.35	0.60
1530		0.35	0.60	0.35	0.45	0.35	0.35	0.50
1600		0.35	0.50	0.35	0.40	0.35	0.35	0.44
1630		0.35		0.35	0.40	0.35	0.35	0.50
1700		0.35		0.35	0.35	0.35	0.35	0.65
1730		0.35		0.35	0.35	0.35	0.37	0.60
1800		0.35		0.35	0.35	0.35	0.40	0.60
1830		<0.35		0.35	<0.35	0.35	0.40	0.40
1900		<0.35		0.35	<0.35	<0.35	0.35	0.40
1930		<0.35		0.35	<0.35	<0.35	0.37	0.70
2000		<0.35		0.35	<0.35	<0.35	0.35	0.60
2030		<0.35		0.35	<0.35	<0.35	0.35	0.55
2100		<0.35		0.35	<0.35	<0.35	0.37	0.35
2130		<0.35		0.37	<0.35	<0.35	0.35	0.35
2200		<0.35		<0.35	<0.35	<0.35	0.35	<0.35
2230		0.35		<0.35	<0.35	<0.35	0.35	<0.35
2300		0.35		<0.35	<0.35	<0.35	0.35	<0.35
2330		0.35		<0.35	<0.35	<0.35	0.35	<0.35
2400		<0.35		<0.35	<0.35	<0.35	0.35	<0.35

continued...

Table 7. Concluded.

August	9	10	11	12	13	14	15	16
Time								
0030	<0.35		<0.35					
0100	<0.35		<0.35					
0130	<0.35		<0.35					
0200	<0.35		<0.35					
0230	<0.35		<0.35					
0300	<0.35		<0.35					
0330	<0.35		<0.35					
0400	<0.35		<0.35					
0430	<0.35		<0.35					
0500	<0.35		<0.35					
0530	<0.35		<0.35					
0600	<0.35		<0.35					
0630	<0.35		<0.35					
0700	<0.35		<0.35					
0730	<0.35		<0.35					
0800	<0.35		<0.35					
0830	<0.35							
0900	<0.35	<0.35						
0930	<0.35	0.36						
1000	<0.35	0.36						
1030	0.35	0.35						
1100	0.35	0.35						
1130	0.35	0.35						
1200		0.35						
1230		0.35						
1300		0.35						
1330		<0.35						
1400		<0.35						
1430		<0.35						
1500		<0.35						
1530		<0.35						
1600		<0.35						
1630		<0.35						
1700		<0.35						
1730		<0.35						
1800		<0.35						
1830		<0.35						
1900		<0.35						
1930		<0.35						
2000		<0.35						
2030		<0.35						
2100		<0.35						
2130		<0.35						
2200		<0.35						
2230		<0.35						
2300		<0.35						
2330		<0.35						
2400		<0.35						

Edmonton. The maximum PAN concentration was reached at 1500 MST just before the onset of thunderstorm activity. (For a detailed description of the meteorology that day, refer to Section 4.6.1.5.2.)

4.3 PAN CONCENTRATIONS AT FORT SASKATCHEWAN

PAN measurements were made from 1983 August 17 to September 16 and from 1984 April 17 to May 5. The results are contained in Table 8. The highest PAN reading during the August-September period was 0.68 ppb and during the April-May period 0.75 ppb. The detection limit for the August-September period was 0.27 ppb and 87% of the 996 measurements fell below this value, thus the means for August (0.21 ppb) and for September (0.14 ppb) have little meaning (Table 8).

During the 1984 April-May period, 95% of the readings were above the detection limit of 0.15 ppb. The mean values for these months were 0.25 and 0.38 ppb respectively, and the mean of the highest values for the 18 days during this period when readings exceeded the detection limit was 0.44 ppb.

The maximum concentration of PAN recorded during this period in Edmonton was considerably higher than at Fort Saskatchewan. A maximum of 2.29 ppb was reached in Edmonton at 1430 MST on April 27, whereas the maximum on that date in Fort Saskatchewan was 0.44 ppb. Details of the meteorology are given in Section 4.6 and trajectories ending at EDMU and at Fort Saskatchewan near the time of the PAN extreme are presented in Figure 79. The trajectories show the influence of the changing synoptic conditions. Air parcels generally moved from the north, stagnated to the southeast of EDMU and Fort Saskatchewan, and finally reached the PAN monitors from the southeast. These paths suggest that the large difference between the EDMU and Fort Saskatchewan extreme concentrations (2.29 versus 0.44 ppb) was due to the path of the air. The EDMU trajectory passed over the city of Edmonton and remained in the vicinity for many hours before reaching EDMU. The Fort Saskatchewan trajectory passed over fewer sources of pollution.

The maximum PAN concentration in Fort Saskatchewan was reached at 1230 MST on April 21. The Fort Saskatchewan maximum of 0.75 ppb did not greatly differ from the 0.93 ppb reached as a maximum on that date in Edmonton.

Table 8. The percentile distribution of maximum readings of PAN measurements made in Fort Saskatchewan 1983 August 17 to 1983 September 16 and 1984 April 17 to 1984 May 05.

Range (ppb)	Number of Readings	Percentile
1983 August		
<0.27 to	190	63.12
0.15 to 0.50	109	36.21
0.51 to 1.00	2	0.66
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00

Total number of readings = 301
Maximum Reading = 0.68 ppb
Average Reading = 0.21 ppb

Range (ppb)	Number of Readings	Percentile
1983 September		
<0.27 to	672	96.69
0.15 to 0.50	22	3.17
0.51 to 1.00	1	0.14
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00

Total number of readings = 695
Maximum Reading = 0.55 ppb
Average Reading = 0.14 ppb

continued...

Table 8. Concluded.

Range (ppb)	Number of Readings	Percentile
1984 April		
<0.15 to	56	8.82
0.15 to 0.50	554	87.24
0.51 to 1.00	25	3.94
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Total number of readings = 635		
Maximum Reading = 0.75 ppb		
Average Reading = 0.25 ppb		
1984 May		
<0.0	0	0.00
0.15 to 0.50	184	90.64
0.51 to 1.00	19	9.36
1.01 to 1.50	0	0.00
1.51 to 2.00	0	0.00
2.01 to 3.00	0	0.00
3.01 to 5.00	0	0.00
> 5.00	0	0.00
Total number of readings = 203		
Maximum Reading = 0.65 ppb		
Average Reading = 0.38 ppb		

At the airport weather stations (Figure 73), southerly surface winds weakened through midday, shifting to westerly and northwesterly in the afternoon. The wind shift and general increase in cloudiness through the day corresponded with the passage of the weak surface front and upper air trough located in southeastern British Columbia (Figure 71). It is estimated that the mixing depth was restricted to about 1 km at EDMU at the time of the PAN maximum, rapidly increasing after that time to more than 2 km by 21/1700 MST when surface temperatures reached 20°C.

The trajectories that terminated at the time of peak concentrations at EDMU (21/1030 MST) and at Fort Saskatchewan (21/1230 MST) are presented in Figure 74. The changing pressure patterns are reflected in the shift of the trajectory directions from southerly to southwesterly at 21/0700 MST. A brief stagnation occurred in both trajectories between 21/1000 MST and 21/1100 MST.

The meteorological conditions suggest that the PAN maxima were associated with air that had previously stagnated over or near the city of Edmonton. The rapid decrease of PAN in the afternoon was apparently tied to increased ventilation with clean air from the northwest, increased cloudiness (decreased direct radiation), and increased mixing depth as a weak front passed the area. Further details are provided in Section 4.6.1.7.3.

4.4. DIURNAL VARIATIONS IN PAN CONCENTRATION

The diurnal pattern of PAN concentration in the Edmonton atmosphere is illustrated in Figure 3 for 1983 March 26 and Figure 4 for 1983 July 25. As seen in both figures 3 and 4, when meteorological conditions were stable, PAN tended to persist at concentrations above the detection limit of 0.15 ppb throughout the night. For the purposes of this report, stability/instability is defined in terms of the temperature lapse rate in the lowest kilometre of the atmosphere. A stable atmosphere is one in which the observed lapse rate is less than the dry adiabatic lapse rate; an unstable atmosphere is one in which the observed lapse rate is greater than the dry adiabatic lapse rate. The degree of stability/instability is proportional to the magnitude of the difference in these lapse rates. If the observed lapse rate is

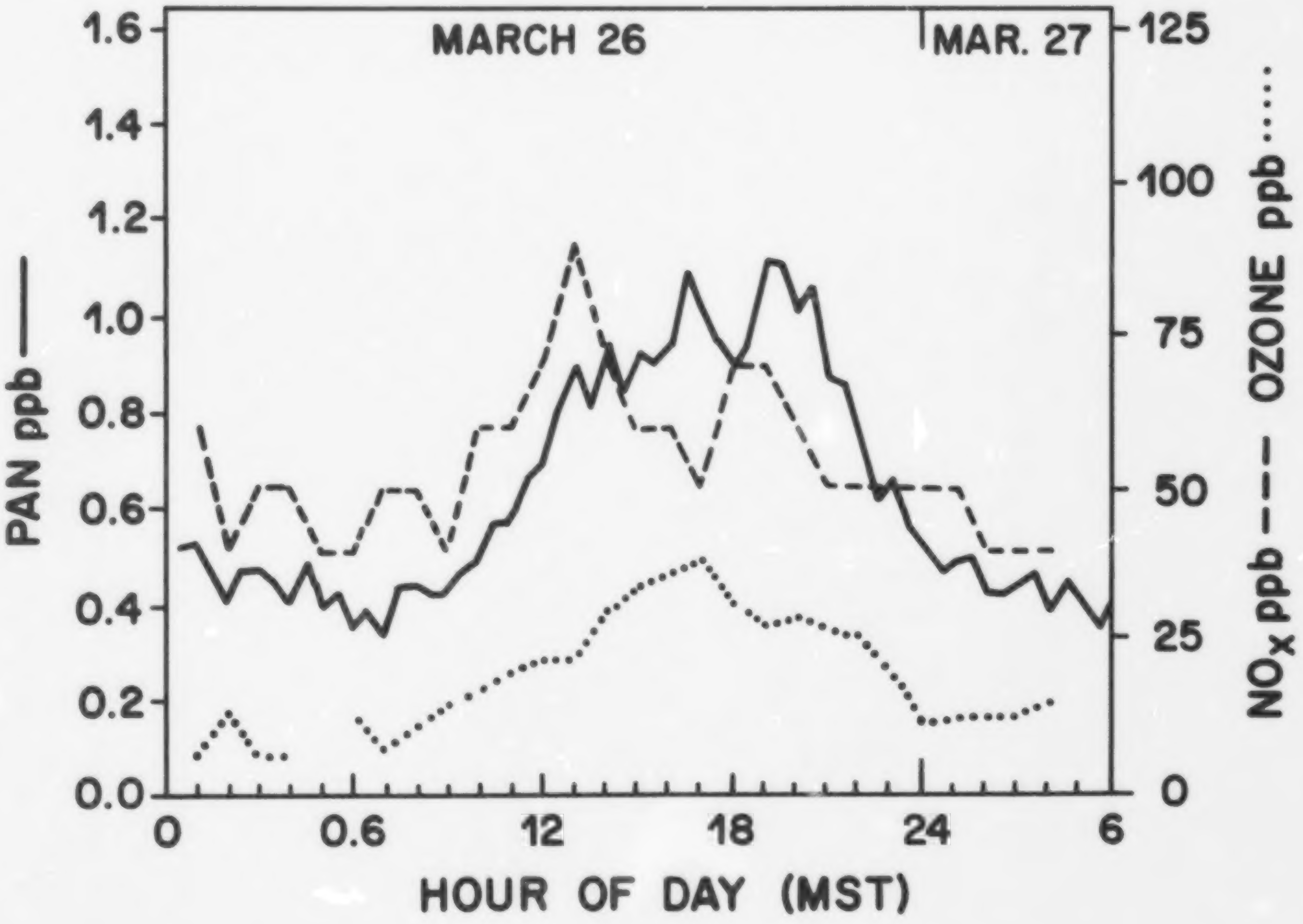


Figure 3. PAN, ozone, and NO_x concentrations in Edmonton, 1983 March 26. Case 1.

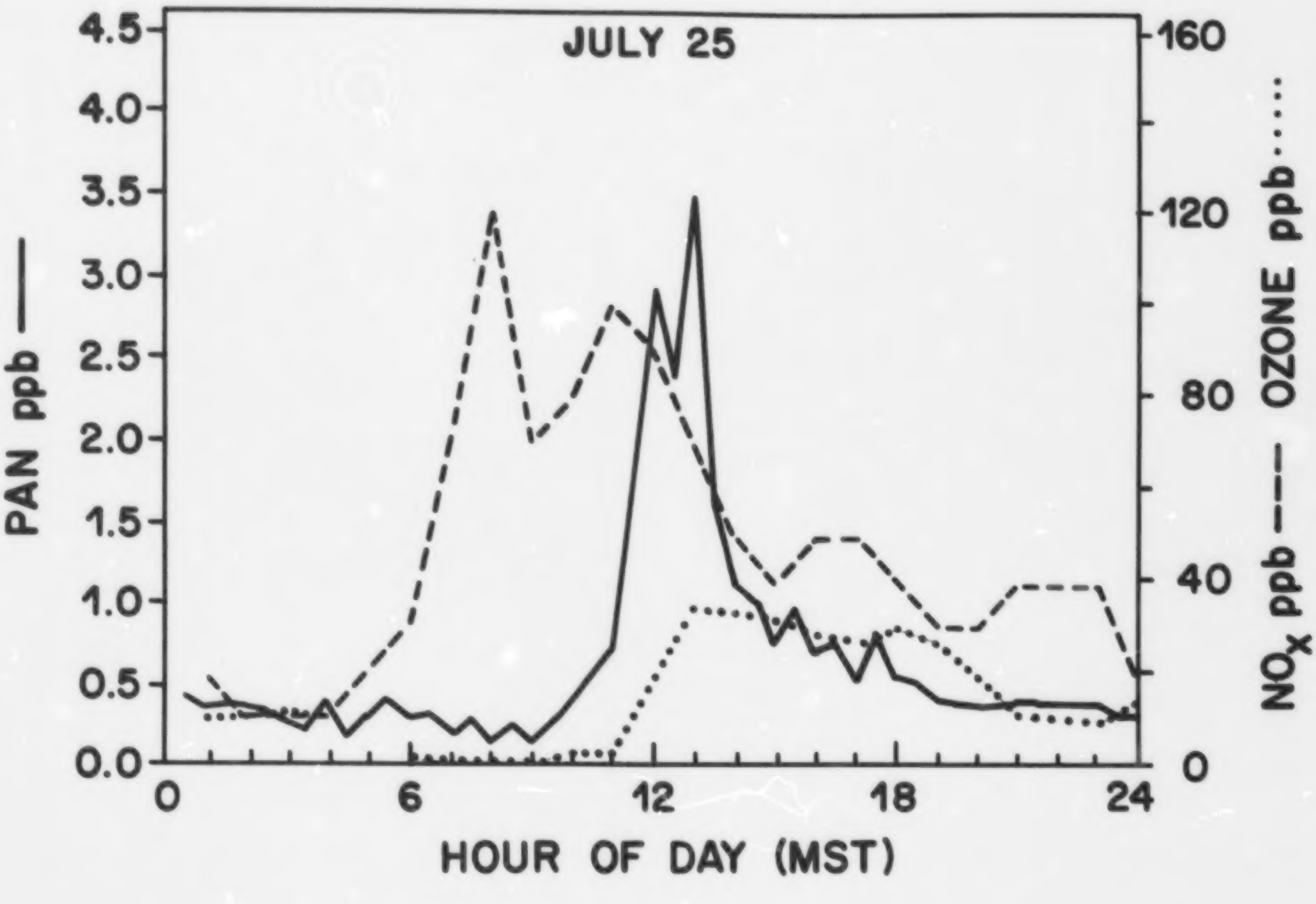


Figure 4. PAN. ozone, and NO_x concentrations in Edmonton, 1983 July 25. Case 4.

exactly adiabatic, the stability is said to be neutral. On March 26, the large-scale meteorological conditions were dominated by ridging aloft and the effects of a frontal zone on the west side of a slowly retreating cold air mass near the surface (Figure 3). The time of PAN maximum corresponded well with the arrival of the upper ridge line and the frontal zone. The day was characterized by stable conditions, light southeasterly winds, and clear skies, giving rise to a heat island over Edmonton. Synoptically, the conditions described a transition state between a retreating cold air mass and an approaching cyclone. The low mixing depths and weak ventilation are similar to pre-chinook conditions,which are conducive to air pollution episodes. These have been described by Lester (1976) and have been recently analysed in detail by Mathews et al. (1983). (Further details are provided in Section 4.6.1.1.1.) PAN concentrations increased gradually from a minimum of 0.36 ppb at 0530 MST to a maximum of 1.12 ppb at 1900 MST before gradually declining to 0.52 ppb by midnight and a minimum of 0.22 ppb at 0430 MST on March 28. Such behaviour is in contrast to the earlier studies in Calgary (Peake and Sandhu 1983), where PAN generally started forming between 0800 to 0900 MST during the summer months, reaching a peak at 1200 to 1300 MST and then declining rapidly. Only rarely in Calgary did PAN persist overnight.

In the 1983 July 25 example (Figure 4), PAN concentrations rose rapidly from a minimum of less than 0.15 ppb at 0800 to a maximum of 3.47 ppb at 1300, followed by a rapid decline to 0.75 ppb by 1500 MST. This is similar to the behaviour found in Calgary. However, in the Edmonton case, more stable daytime conditions allowed the PAN to persist, whereas in Calgary unstable conditions dispersed the pollutants. Further analysis of the data is required to obtain average profiles to compare seasonal trends.

The Ellerslie data were too few to show repeated trends in diurnal PAN concentrations. They did, however, follow the trend of early afternoon maxima, usually declining below the detection limit of 0.35 ppb at night. On one evening, the night of August 7-August 8, PAN did persist overnight.

The trend in Fort Saskatchewan was for nearly continuous PAN measurements above the detection limit of 0.15 ppb for the entire monitoring period in the spring of 1984. Maximum concentrations usually occurred in mid-afternoon but on some days as early as 0900 MST or as late as 2000 MST. The maxima generally occurred at approximately the same time in Fort Saskatchewan as in Edmonton, indicating local generation of PAN. However, on some days the maxima occurred one to two hours later at Fort Saskatchewan, indicating either transport of PAN from Edmonton or generation of PAN during transport of pollutants from Edmonton.

4.5 FACTORS INFLUENCING PAN FORMATION

The formation of PAN is believed to be initiated by the reaction of hydroxyl radicals with olefins or aldehydes to form peroxyacyl radicals. Peroxyacyl radicals react with nitrogen oxides to form peroxyacyl nitrates (Stephens 1969; Lonneman et al. 1976). Thus, a close relationship might be expected to exist between the occurrence of the primary pollutants, nitrogen oxides and hydrocarbons, with that of the secondary pollutants, ozone and PAN. Such a relationship is well known for the nitrogen oxides and ozone; nitric oxide is oxidized to nitrogen dioxide leading to the formation of ozone (National Research Council 1977). It is not the absolute amount of nitrogen oxides that controls the abundance of ozone, rather it is the ratio of the nitrogen dioxide to nitric oxide. The mechanisms of PAN formation are quite different from those of ozone. Peroxyacetyl nitrate is the terminal product of a chain of free radical reactions, whereas with ozone the generation process is self-perpetuating.

In Edmonton, the primary pollutants (nitrogen oxides, carbon monoxide, and hydrocarbons) show similar diurnal concentration patterns. The maximum concentration of each occurs at the same time on a given day. The hydrocarbon concentrations, however, show far less variation than do the carbon monoxide and nitrogen oxides. Information is limited,but the non-methane hydrocarbon to NO_x ratios in Calgary are thought to be greater than 20 and sufficient reactive hydrocarbons are believed to be available at all times to participate in the formation of peroxyacyl radicals.

As shown by the monthly means in Table 4, the highest concentrations of PAN occurred in August. This may be explained on the basis of solar radiation intensity and duration, temperature, and pollutant concentrations. In the winter, concentrations of primary pollutants are high but the intensity and duration of solar radiation and the atmospheric temperature are low. During autumn, the possibility exists for the simultaneous occurrence of high levels of pollutants and high solar radiation and temperatures, resulting in the generation of PAN. Thus, solar radiation is believed to be the limiting factor in the formation of PAN during the winter in Edmonton (5^{o}N), whereas the abundance of the primary pollutants, the precursors of PAN, is the limiting factor in the summer. The results in Edmonton are similar to those previously found in Calgary and contrast with those from the Los Angeles basin (31^{o}N), where evidence suggests that solar radiation is not a limiting factor.

Temperature is one of the factors that influence the rate of PAN generation (Carter et al. 1979). Most PAN measurements have been made in the southern United States, where temperatures are higher. Other measurements of PAN have been made mostly during the summer months in the more northerly United States and in Europe. However, in an earlier study in Calgary, PAN was found on several days when the temperature did not exceed 0^{o}C.

In Edmonton on 1983 March 26, the PAN concentration reached 1.12 ppb and the temperature maximum was 6^{o}C with skies nearly clear and light winds.

4.6 CASE STUDIES OF PAN, OZONE, AND NITROGEN OXIDE RELATIONSHIPS

The oxidants, PAN and ozone, are generated by related photochemical processes, and in Edmonton the diurnal variations in these pollutants often showed similar trends (figures 3 and 4).

The peak afternoon concentration of PAN is much less than the corresponding ozone maximum. During episodes of high concentrations of photochemical smog in Los Angeles, or in Japan, ozone:PAN ratios of 10 have been reported (Taylor 1969; Izumikawa et al. 1975). In Europe, ratios are commonly 50 (Nieboer and van Ham 1976; Brasser et al. 1977; Penkett 1978). In downtown Edmonton, as in Calgary, ratios were relatively low (Table 9). Such low ratios occurred when the background

Table 9. Ozone/PAN ratios based on maximum afternoon values for selected days in downtown Edmonton, Ellerslie, and Fort Saskatchewan.

	Edmonton	Ellerslie	Fort Saskatchewan
1983 Mar 26	40		
1983 Apr 28	30		
1983 Jun 28	17		
1983 Jun 29	19		
1983 Jun 30	14		
1983 Jul 25	10	123	
1983 Aug 02	11	80	
1983 Aug 03	28	60	
1983 Aug 04	23	110	
1983 Aug 05	15	62	
1983 Aug 21	30		166
1983 Aug 22	16		183
1983 Aug 23	6		226
1983 Aug 24	14		250
1983 Aug 26	21		138
1984 Apr 19	8		165
1984 Apr 20	41		71
1984 Apr 21	43		81
1984 Apr 27	18		136
1984 Apr 28	16		107

concentration of ozone was apparently suppressed by nitrogen oxides followed by photochemical ozone and PAN formation.

4.6.1 Case Studies

On the basis of PAN concentration and duration, some 20 "episodes" contained in 8 "cases" were selected for meteorological analysis. These are listed in Table 10.

4.6.1.1 Case 1, 1983 March 26. Case 1 is characterized by a broad PAN peak exceeding 0.80 ppb between about 26/1230 MST and 26/2130 MST with a maximum of 1.12 ppb occurring about 26/1900 MST (Figure 3). Ozone followed the same trend, rising from a minimum of 8 ppb at 0700 MST to 39 ppb at 1700 MST before declining to 12 ppb at 2400 MST. Nitrogen oxide concentrations rose to a maximum of 90 ppb at 1300 MST, declining to a minimum of 50 ppb at 1700 MST when ozone reached a maximum. Nitrogen oxides then increased as ozone declined, reflecting a drop in the $NO:NO_2$ ratio from 1.0 to 0.5. For analysis purposes, Case 1 was defined as 26/0500 MST through 27/0500 MST, i.e., the period during which PAN concentrations exceeded 0.50 ppb.

As observed at YED, YXD, and YEG (Figure 5), weather conditions during the PAN event were characterized by generally clear skies, but with cloudiness prevailing on both preceding and succeeding days. Temperature minima were near $-9^{o}C$ (YEG) and maxima as high as $6^{o}C$ (YXD). Taking the difference in the YXD (urban) and YEG (rural) temperatures as an indication of the intensity of the urban heat island, a heat island was established over Edmonton by 2300 MST, 1983, March 26. The heat island intensified after midnight but was weaker than what Hage (1972) described as an "intense heat island" (i.e., $4C^{o}$ versus $6C^{o}$). Visibility was lower during the period in question due to haze, with typical values in the 10 to 20 km range. In comparison, the visibility before and after the PAN event was typically 25 km or more. During the case period, YED reported the lowest visibility. Winds were southerly in the early morning hours of March 26. After a period of calm about noon, winds became easterly, shifting to ESE at 19 $km \cdot h^{-1}$ or less about the time of the PAN maximum. Thereafter the directions continued to veer toward SE and SSE.

Table 10. PAN cases and episodes selected for meteorological analysis.

Case	Episode	Date	Time of PAN maximum (MST)	Episode Maximum PAN Concentration[a] (ppb)
		1983		
1	1	Mar 26	1900	1.12
2	1	Apr 28	2000	1.24
3	1	Jun 28	1430	2.43
	2	Jun 29	1030	2.06
	3	Jun 30	0330	1.18
4	1	Jul 25	1300	3.47
5	1	Aug 02	0900	3.50
	2	Aug 03	1630	0.92
	3	Aug 04	1230	1.63
	4	Aug 05	1000	1.82
6	1	Aug 21	2100	0.86
	2	Aug 22	1230	2.26
	3	Aug 23	0930	7.51
	4	Aug 24	1400	3.30
	5	Aug 26	1100	1.42
		1984		
7	1	Apr 19	1730 (1730)[a]	1.03 (0.20)[a]
	2	Apr 20	2000 (2200)	1.12 (0.62)
	3	Apr 21	1030 (1230)	0.93 (0.75)
8	1	Apr 27	1930 (1730)	2.29 (0.44)
	2	Apr 28	0830 (0900)	1.00 (0.54)

[a] Maximum value obtained from measurement taken each half-hour. A given PAN episode may have one or more secondary maxima: for cases 7 and 8, numbers in parentheses refer to Fort Saskatchewan.

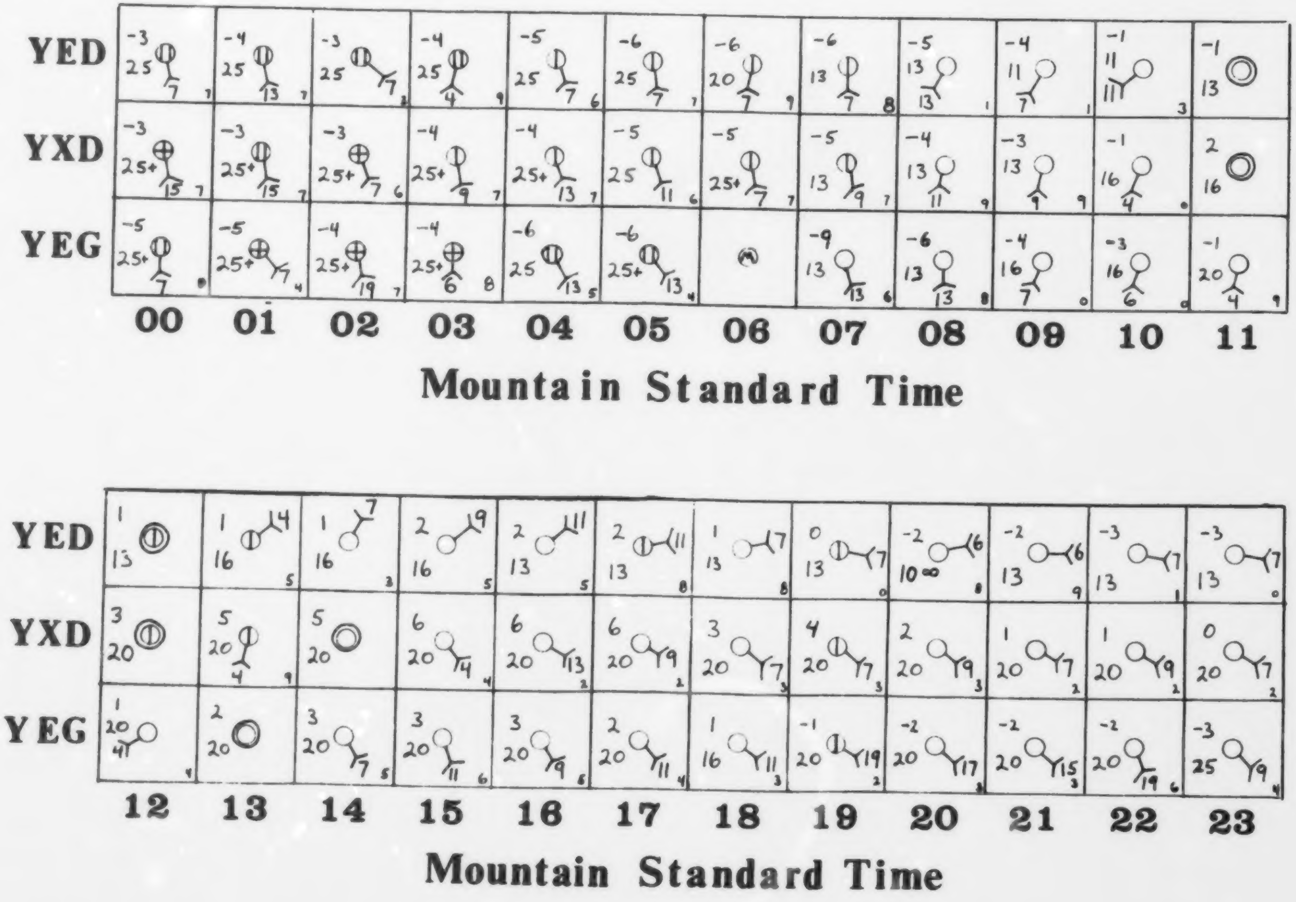


Figure 5. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 March 26. Case 1. Explanation of symbols appears in Table 2.

During Case 1, the large-scale meteorological conditions were dominated by ridging aloft and the effects of a frontal zone on the west side of a slowly retreating cold air mass near the surface (Figure 6). The time of PAN maximum corresponded well with the arrival of the upper ridge line and the frontal zone. The front was embedded in a weak pressure gradient conducive to light southeasterly flow at the surface. Aloft, winds veered to westerly, finally becoming southerly though a deep layer after the ridge passed. Subsidence associated with the ridge aloft and the descent of the stable layer associated with the retreating frontal zone are in good agreement with the clear skies, generally hazy conditions, and light winds. Assuming that the Stony Plain radiosonde is representative of the area, maximum mixing depths were only of the order of 200 m, possibly reaching 250 to 300 m over the city at the time of maximum temperature. The 12-hour surface trajectory (Figure 7) that terminated at EDMU at the PAN peak (26/1900 MST) shows that the air parcel originated SSE of Edmonton.

In summary, Case 1 was characterized by strong stability, light southeasterly winds, and clear skies, giving rise to a heat island over Edmonton. Synoptically, the conditions described a transition state between a retreating cold air mass and an approaching cyclone. The low mixing depths and weak ventilation are similar to pre-chinook conditions, which are conducive to air pollution episodes. These have been described by Lester (1976) and have been recently analysed in detail by Mathews et al. (1983).

4.6.1.2 Case 2, 1983 April 28. Case 2 was similar to Case 1, consisting of a single PAN episode with a peak concentration of 1.24 ppb at 28/2000 MST (Figure 8). PAN concentrations exceeded 0.80 ppb from about 28/1730 MST to about 28/2130 MST, i.e., the episode was shorter and more peaked than Case 1. For analysis purposes, Case 2 is defined as occurring from 28/0500 MST to 29/0500 MST.

Ozone did not closely follow the PAN trend. The maximum ozone concentration occurred at 1500 MST shortly after a major decline of the nitrogen oxides from 180 ppb to 40 ppb.

With few exceptions, weather observations at the three local airports (Figure 9) indicated generally scattered clouds (coverage 30%

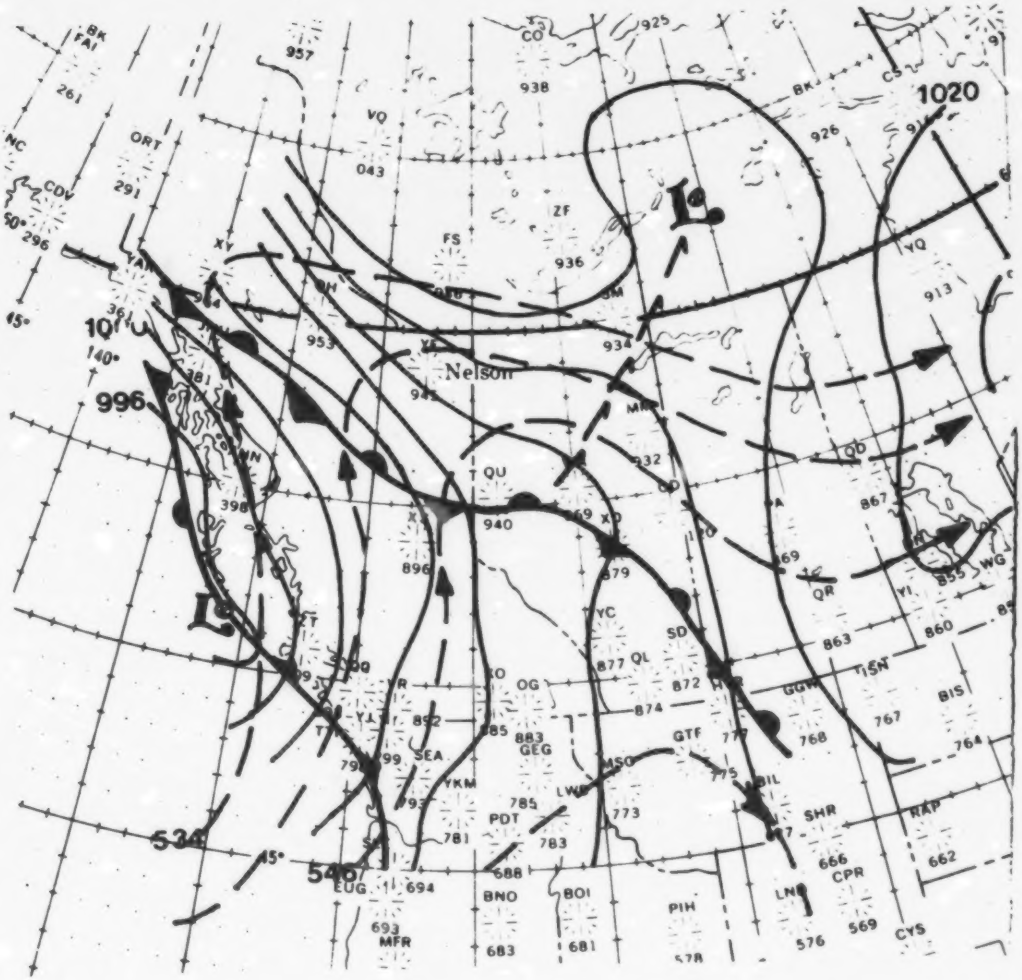

1020
996
534
546
L
L
Nelson
50°
45°
140°
BK
FAI
261
NC
CDV
296
ORT
291
XY
YA
957
VQ
043
CO
938
925
ZF
936
FS
BH
953
YE
945
QU
940
XD
879
YC
877
QL
872
SD
874
OG
883
GEG
SEA
YKM
785
PDT
783
LWS
MSO
773
GTF
775
BIL
SHR
666
CPR
569
LND
576
CYS
RAP
662
BIS
764
767
GGW
768
ISN
863
860
QR
855
WG
YI
867
QD
913
YQ
926
CS
934
932
896
398
381
EUG
694
693
MFR
BNO
683
688
BOI
681
PIH
578

Figure 6. Composite surface and 500 mb analysis for 1983 March 26 at 1700 MST. Case 1. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

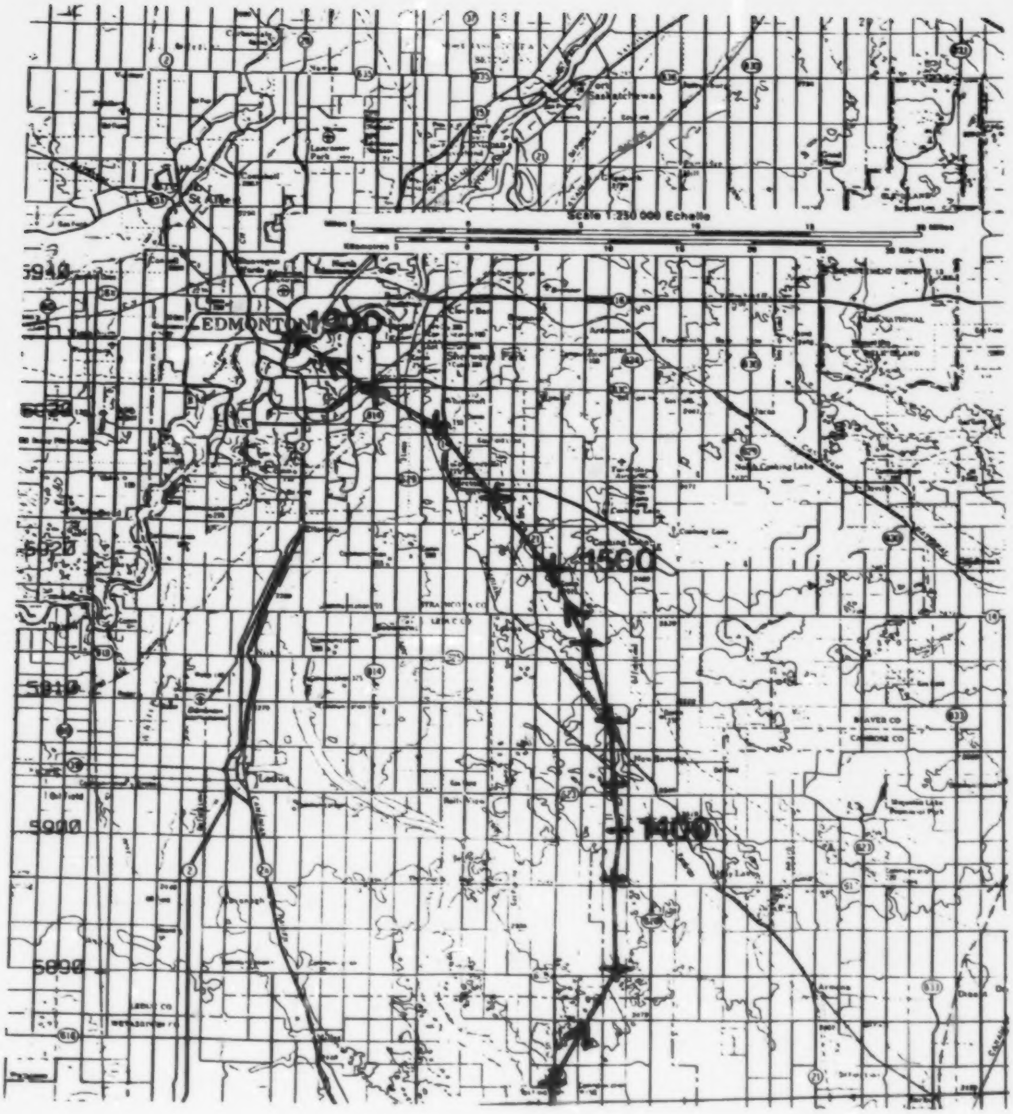

EDMONTON
1900
1500
1400
St. Albert
Scale 1:250 000 Echelle
5940
5930
5920
5910
5900
5890

Figure 7. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1900 MST, 1983 March 26. Case 1. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

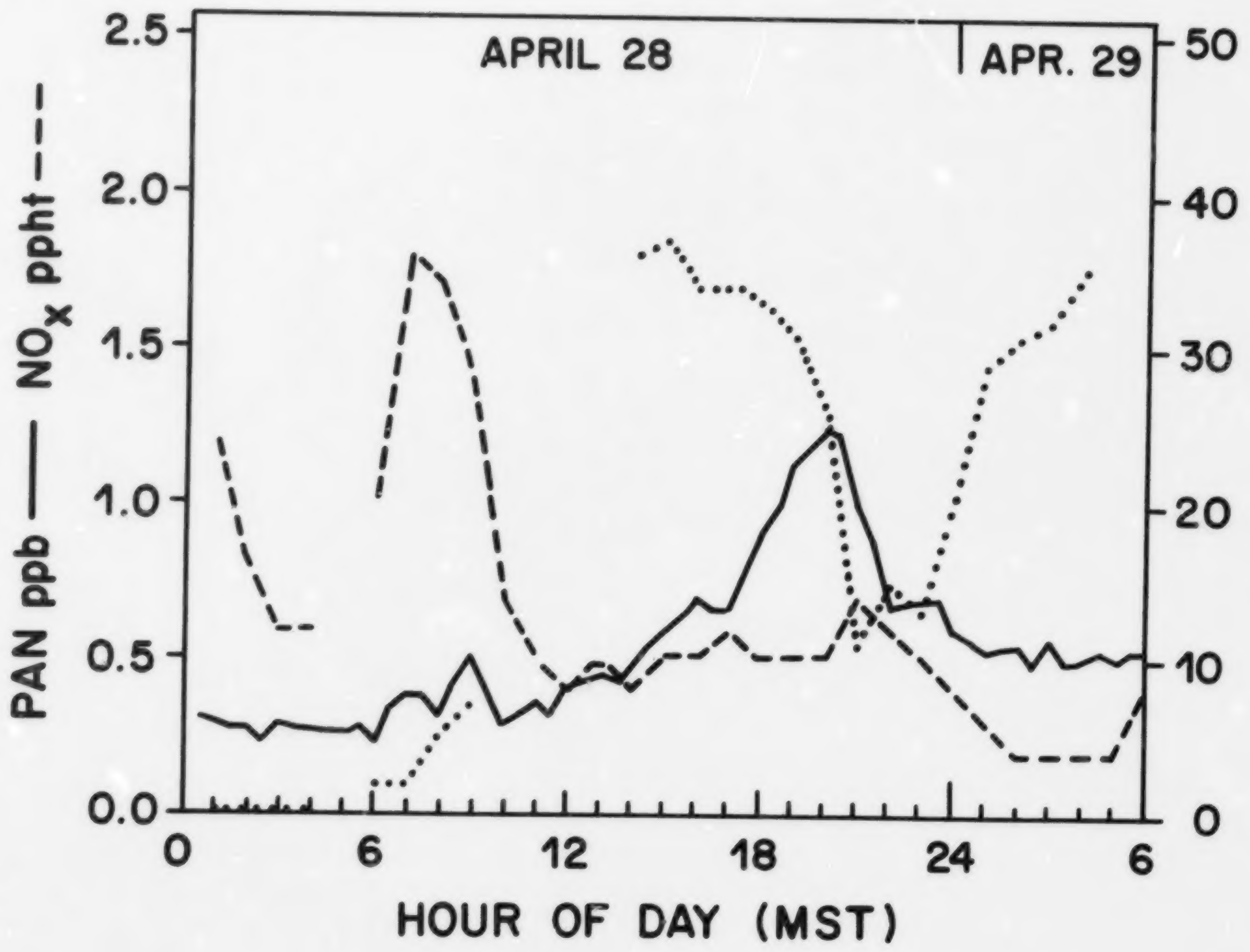


Figure 8. PAN, ozone, and NO_x concentrations in Edmonton, 1983 April 28. Case 2.

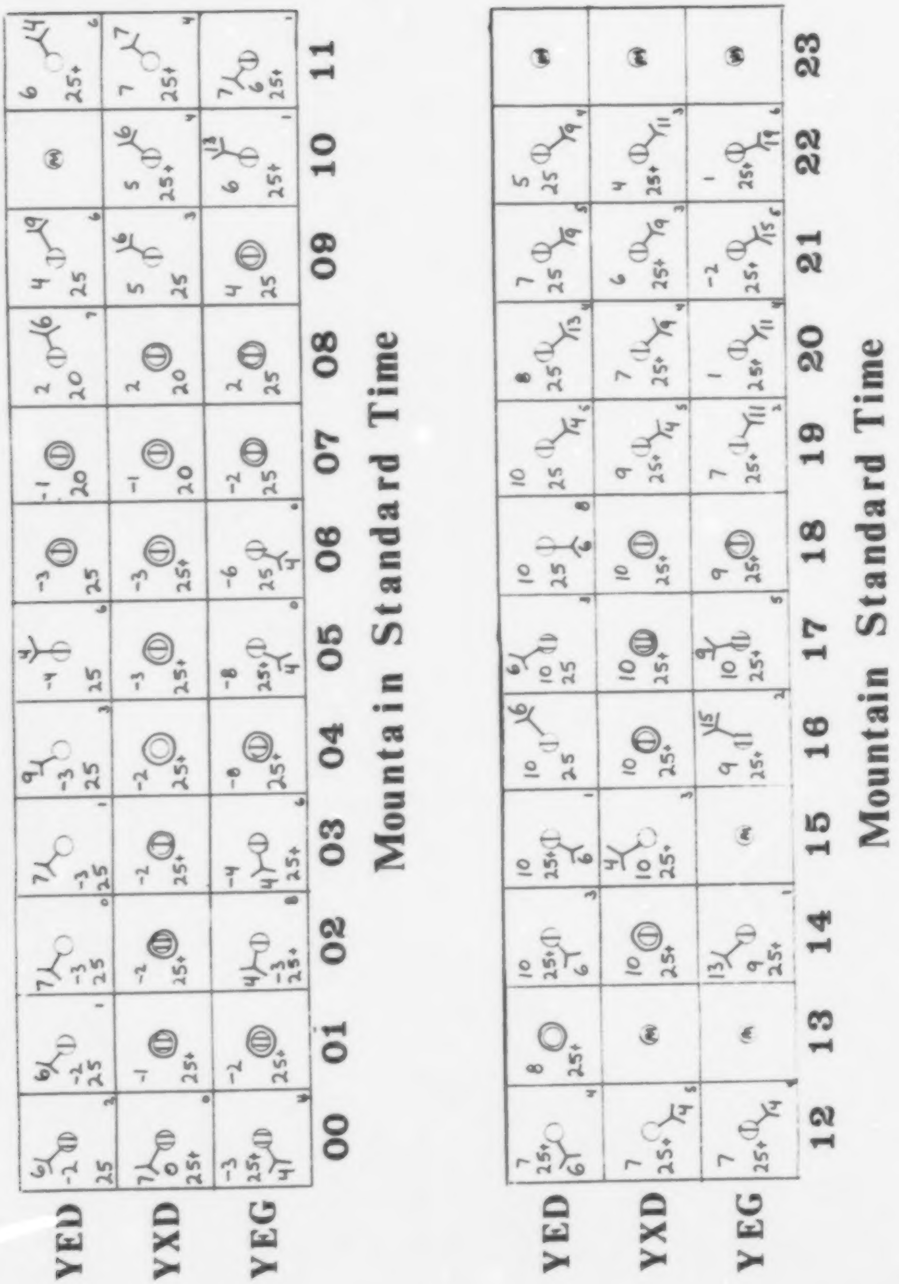


Figure 9. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 April 28. Case 2. Explanation of symbols appears in Table 2.

or less) after 28/0200 MST. Visibility was good in contrast to Case 1, with most reported hourly values greater than 25 km, although smoke was reported over the city for three hours beginning at 28/0600 MST.

Surface temperatures varied from a minimum of -8°C at Edmonton International to a maximum of 10°C recorded at all stations. An intense heat island was well established at 28/2100 MST (YXD-YEG temperature difference of $8C^{\circ}$). Winds were less than 15 $km \cdot h^{-1}$ from the north (NE-NW) to calm at all three locations until about 28/1900 MST. At that time, all winds became southeasterly in the 10 to 15 $km \cdot h^{-1}$ range. The wind shift was particularly noticeable at International airport, where the temperature also fell by 6°C in the hour after the shift.

Synoptic conditions (Figure 10) also showed some similarities to Case 1 with a transient upper level ridge passing over Edmonton near the time of the PAN maximum. Unlike Case 1 where the ridge moved over the area from the southwest, in Case 2 the ridge aloft moved in from the northwest. At the surface, a cool air mass retreated to southeastern Alberta with a diffuse, quasi-stationary front marking the western edge of the airmass.

The development of a surface low pressure area over British Columbia (Figure 10) and, subsequently, over northwestern Alberta affected the wind significantly during the case period. Southeasterly flow was induced over the central part of the province a few hours previous to the time of the PAN maximum. In addition, the frontal zone to the east of Edmonton (Figure 10) was carried westward within the fresh surge of easterlies.

The trajectory that terminated at EDMU at the time of the PAN maximum shows that the air parcel originated near Fort Saskatchewan earlier that day (Figure 11). The change in the orientation of the trajectory southeast of Edmonton reflects the wind shift discussed above. It is possible that synoptic wind field was enhanced by the valley circulation in the first few hours of the trajectory and then by the urban heat island, which was well developed near the time the trajectory terminated.

In summary, Case 2 was marked by a surface layer with weak northerly flow and strong vertical mixing (mixing depth about 1700 m,

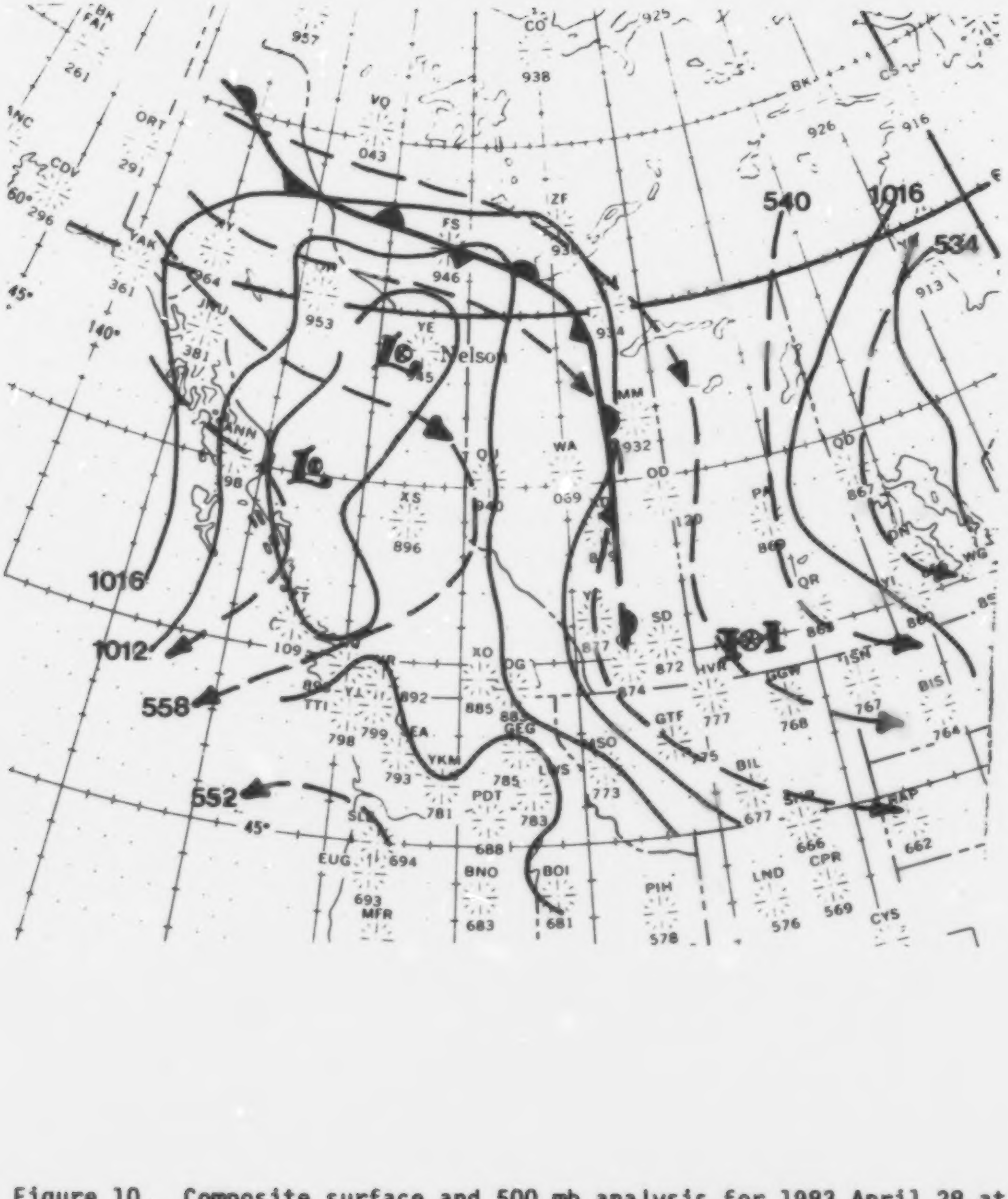

1016
1012
558
552
540
1016
534
Nelson
L
L
45°
60°
140°
45°
FAI
ANC
ORT
CDV
YAK
JNU
ANN
VQ
CO
ZF
FS
YE
XS
QU
WA
OD
MM
SD
HVR
GTF
BIL
SHR
RAP
BIS
ISN
GGW
QR
PA
QD
WG
XO
OG
GEG
LWS
MSO
PDT
YKM
SEA
TTI
SLE
EUG
MFR
BNO
BOI
PIH
LND
CPR
CYS
BK
CS

Figure 10. Composite surface and 500 mb analysis for 1983 April 28 at 1700 MST. Case 2. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

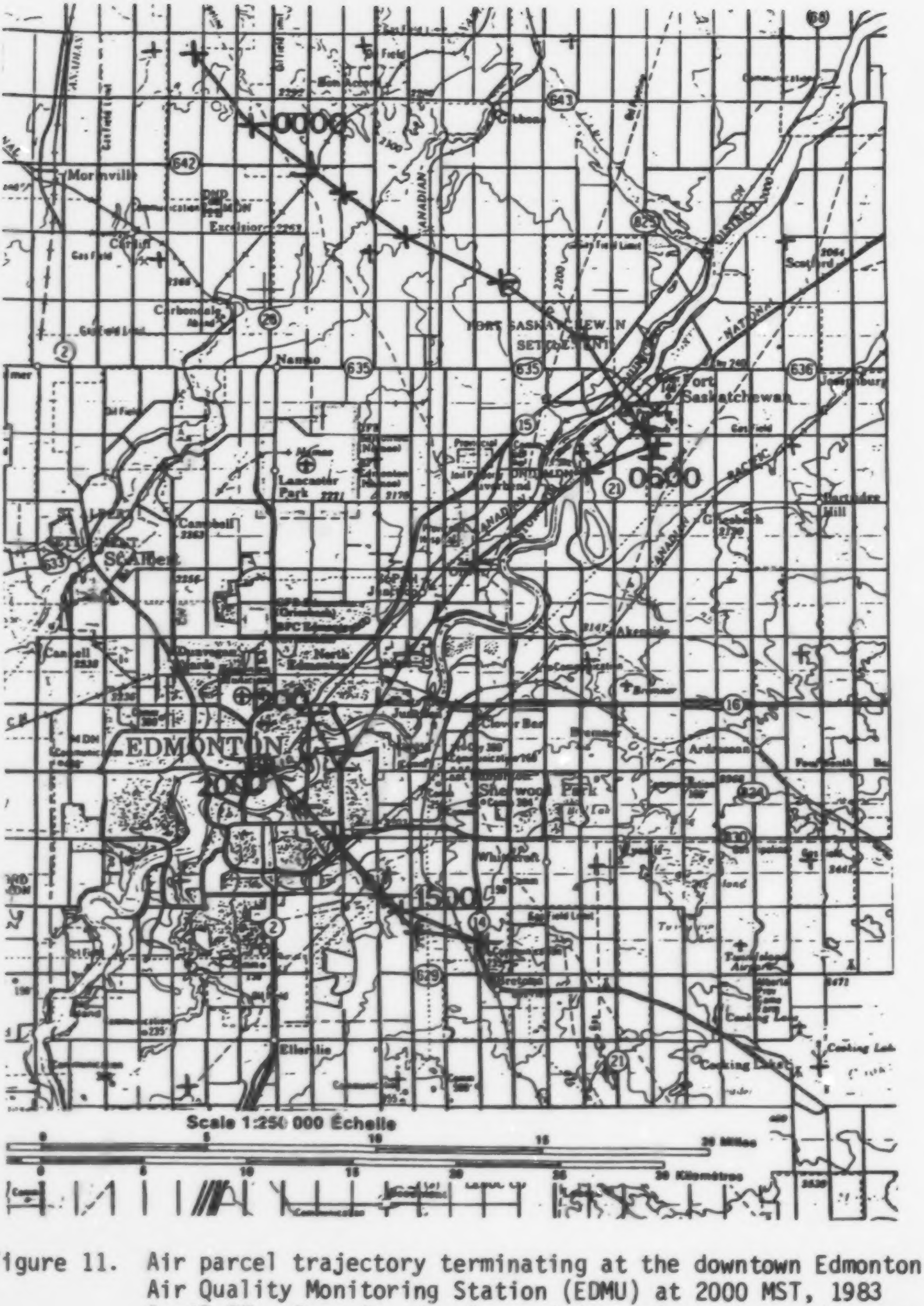

0000
0500
1500
2000
EDMONTON
St. Albert
Morinville
Fort Saskatchewan
Sherwood Park
Lancaster Park
Namao
Cardiff
Gibbons
Ellerslie
Cooking Lake
Scale 1:250 000 Échelle
Miles
Kilomètres

Figure 11. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 2000 MST, 1983 April 28. Case 2. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

as indicated by the height of the cumulus) through the late morning on April 28. A developing low pressure area in the northwest of the province induced southeasterly surface flow over the area. Normal diurnal cooling, coupled with the return of the frontal boundary from the east and weak ridging aloft, provided decreased mixing depths conducive to a pollution event. Air that originated over Edmonton about 1200 was carried back into the city at about 2000, which may account for the late PAN peak.

4.6.1.3 Case 3, 1983 June 28 to 30. Case 3 is composed of three episodes (Table 10, Figure 12). They are discussed as a single case because of their juxtaposition in time. Figure 12 shows PAN concentrations for the entire case. Episodes 1 and 2 correspond with June 28 and June 29, when PAN reached daytime maxima of 2.43 ppb and 2.06 ppb, respectively. Episode 3 includes the night-time maximum (1.18 ppb) that occurred on the morning of 1983 June 30.

Large-scale surface and upper air conditions over southern Alberta (figures 14 and 19) during late June were dominated by a series of weak cyclonic disturbances moving east-northeastward from the Gulf of Alaska. The three episodes discussed below occurred under the influence of an upper anticyclonic disturbance between two transient cyclones.

4.6.1.3.1 Case 3, Episode 1, 1983 June 28. Episode 1 is characterized by a broad PAN event with a primary maximum of 2.43 ppb at 1430 MST (Figure 12). Except for three relatively small peaks in the early morning hours, the main activity occurred between about 18/0900 MST and 28/2300 MST. The record displays the characteristic asymmetry of many of the other cases, with a rapid rise followed by a more gradual decline.

Ozone concentrations followed the same trend as PAN, rising from 30 ppb at 0700 MST to 42 ppb at 1600 MST. Ozone and PAN concentrations rose as nitrogen oxides declined from 70 ppb at 0700 MST to 50 ppb at 1300 MST.

Meteorological conditions were marked by overcast skies, rain, fog, and low visibility at the three area airports in the early morning

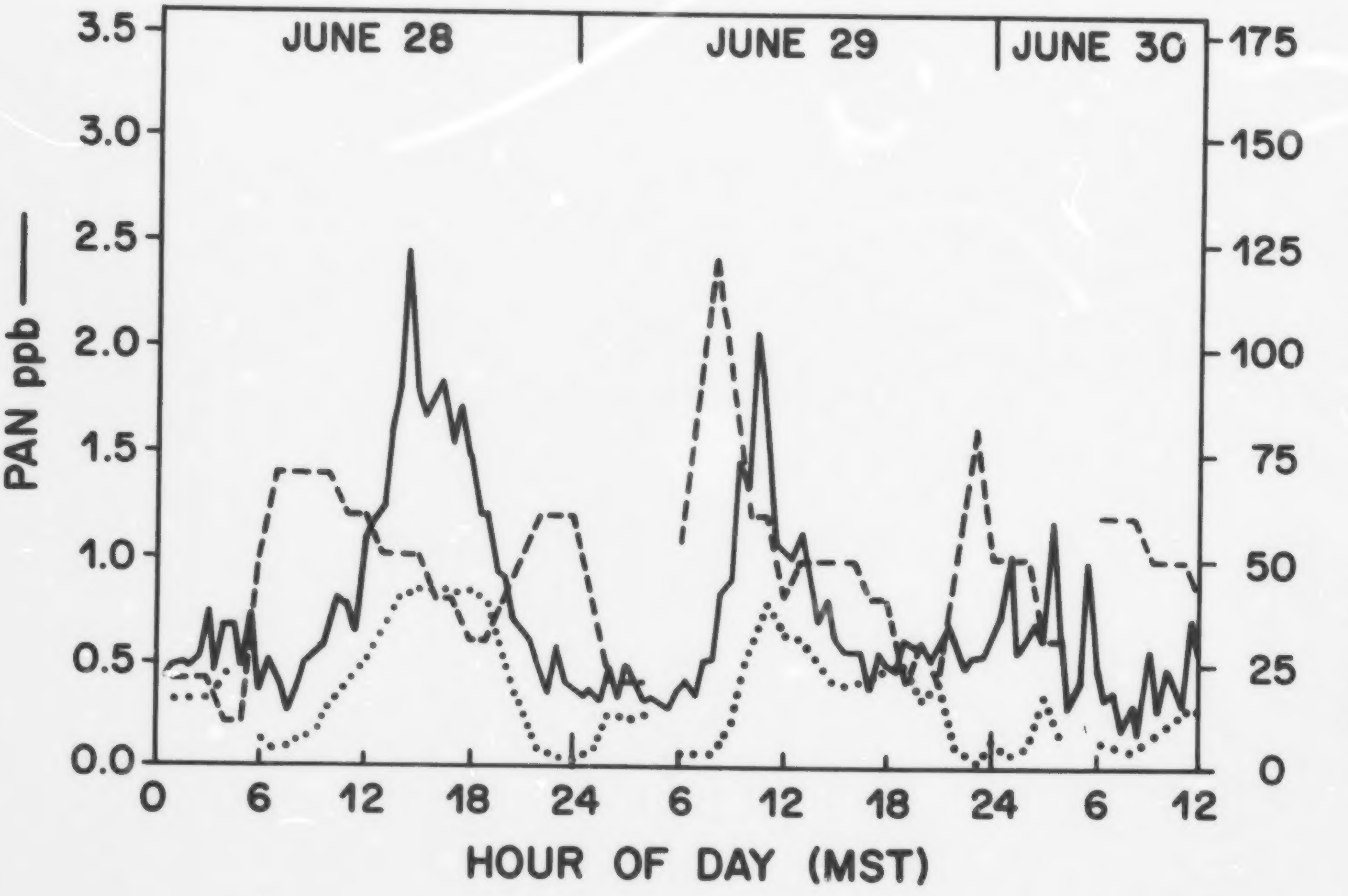


Figure 12. PAN, ozone, and NO$_x$ concentrations in Edmonton, 1983 June 28, 29, and 30. Case 3, episodes 1, 2, and 3.

hours of June 28 (Figure 13). Conditions generally improved throughout the day with good visibility, 50% or less sky cover, and very light winds by the time of the PAN maximum. Wind directions became more southerly and speeds increased to 5 to 10 km·h^{-1} during the rest of the day. The maximum temperature reached 22°C with maximum mixing depths near 800 m above ground (AGL). The YXD-YEG temperature difference was 6C° late in the evening of June 28 as a well-defined heat island was established.

The large-scale meteorological conditions that prevailed on the afternoon of 1983 June 28 are shown in Figure 14; the eastward-progressing upper level cyclone and the associated surface low over western Saskatchewan and eastern Montana produced the rain that occurred in Edmonton earlier in the day. Subsiding motions associated with the trailing ridgeline (most noticeable in the 500 mb flow pattern) accounted for the afternoon improvement in conditions. The southerly and southeasterly winds observed around Edmonton (Figure 13) were evidently a response to the surface low approaching the Continental Divide from the west.

The trajectory that terminated at the Edmonton EDMU at 28/1500 MST is shown in Figure 15. Apparently the trajectory was first under the influence of the surface cyclone that moved into Montana early in the day and then responded to the weak southerly flow ahead of the next disturbance (Figure 14).

4.6.1.3.2 Case 3, Episode 2, 1983 June 29. The PAN record of Episode 2 (Figure 12) shows many similarities to Episode 1. After two minor events in the early morning hours, there was a rapid rise to a maximum half-hour concentration of 2.06 ppb at 1030 MST followed by a more gradual decrease. Aside from two early morning peaks, PAN concentrations exceeded 0.5 ppb after 0730 MST and were generally at or above that value for the rest of the day. In contrast with the preceding day, the peak occurred four hours earlier.

Ozone concentrations reflected the PAN trend rising to a maximum of 39 ppb at 1100 MST and thereafter declined to 19 ppb by 1500 MST. Nitrogen oxides reached a peak of 120 ppb at 0800 MST, dropping rapidly as ozone and PAN increased. By 1200 MST nitrogen

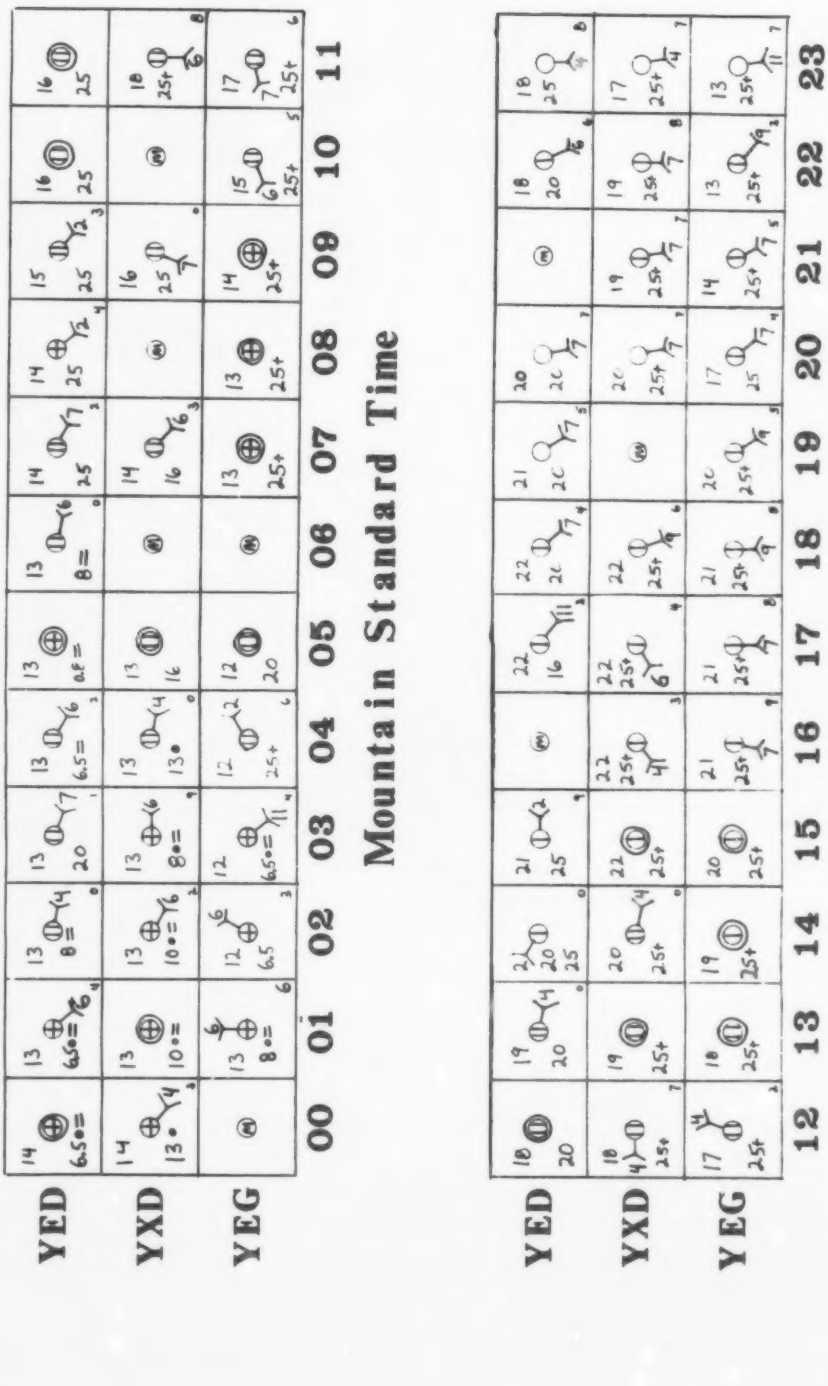


Figure 13. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 June 28. Case 3, Episode 1. Explanation of symbols appears in Table 2.

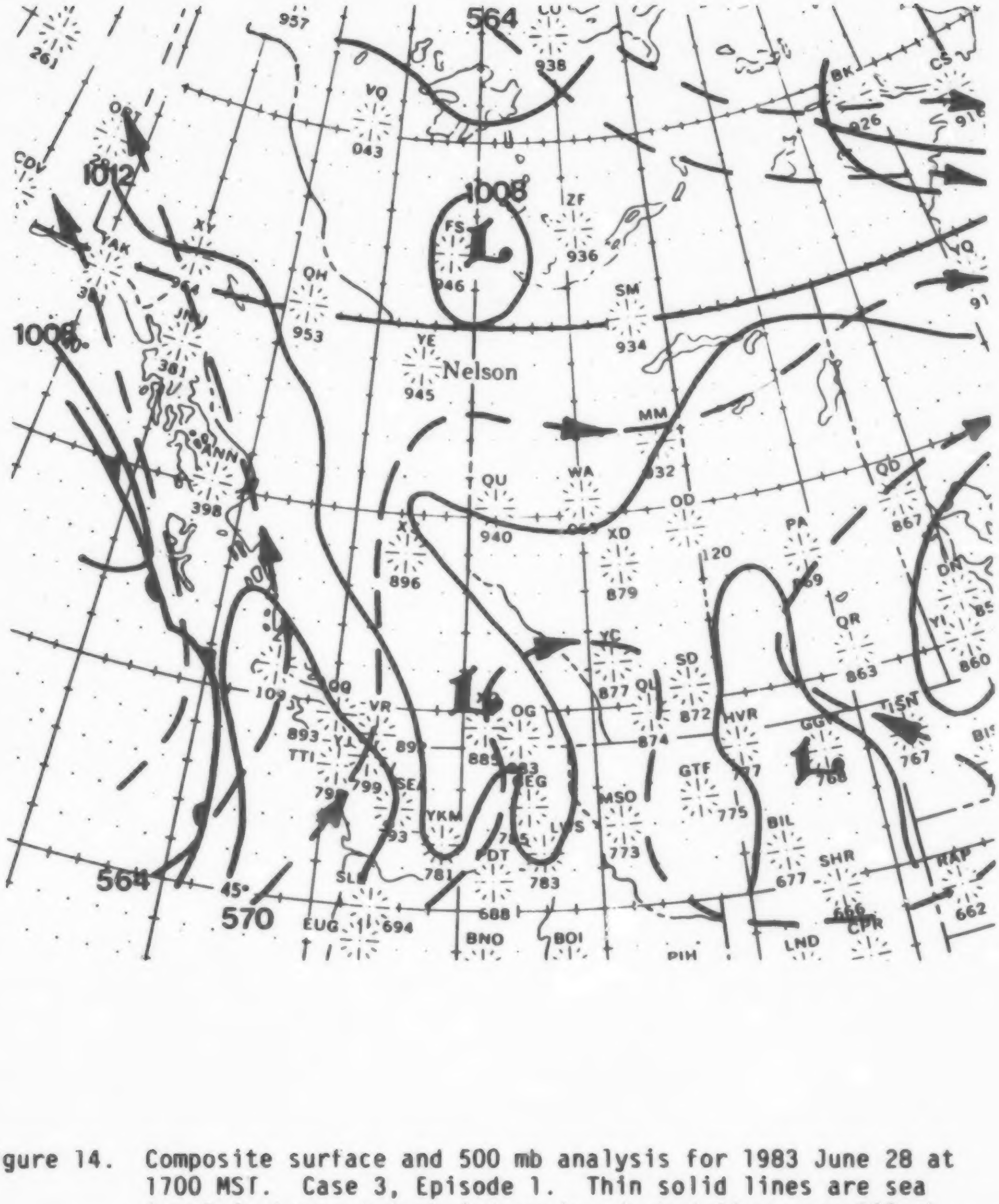

564
1012
1008
1008
L
L
L
Nelson
564
570
45°
VQ
FS
ZF
SM
YE
QH
XY
YAK
JNU
ANN
MM
QU
WA
OD
XD
PA
QB
DN
YI
QR
YC
SD
QL
HVR
GG
GTF
BIL
SHR
RAP
CPR
LND
PIH
BOI
BNO
EUG
SLE
PDT
YKM
SEA
TTI
YJ
VR
OG
GEG
LWS
MSO
ISN
BIS
BK
CS
CDV
957
938
043
936
946
953
934
945
932
940
896
879
120
869
867
863
860
877
872
874
777
768
767
775
773
783
677
666
662
694
688
781
785
893
799
885
398
381
364
261

Figure 14. Composite surface and 500 mb analysis for 1983 June 28 at 1700 MST. Case 3, Episode 1. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

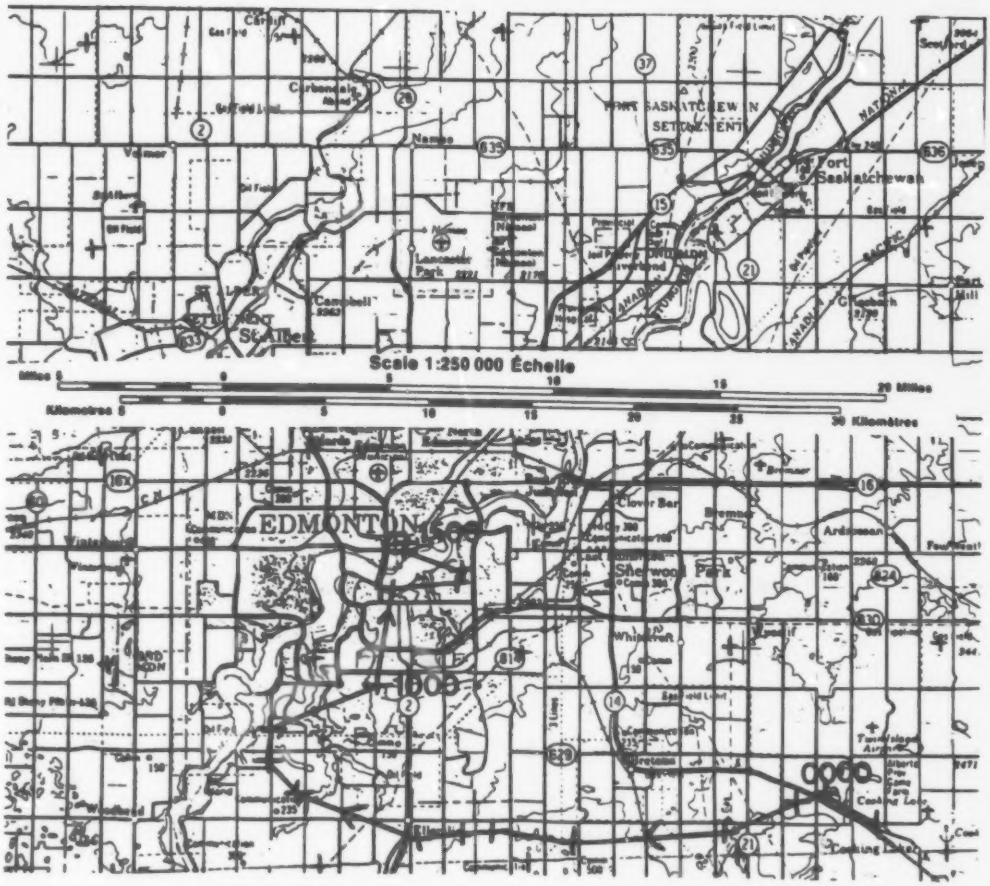

Scale 1:250 000 Échelle
Miles
Kilomètres
20 Miles
30 Kilomètres
EDMONTON
1500
1000
0000
St Albert
Fort Saskatchewan
Sherwood Park
Cooking Lake

Figure 15. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1500 MST, 1983 June 28. Case 3, Episode 1. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

oxides had declined to 40 ppb and the $NO:NO_2$ ratio had declined from 2 to 1.

As shown in Figure 16, 1983 June 29 began with only a few clouds, good visibility, and light winds. The morning minimum temperature at YEG reflected these conditions (9°C vs. 13°C the previous morning). Mixing depths were restricted until about noon. At the time of the PAN max, the depth of the mixing layer was only 300 or 400 m. However, just after noon, the nocturnal inversion was destroyed, and mixing depth increased to 2000 m or more as surface air temperatures rose to 24°C. Clouds also increased during the day, exceeding 50% coverage at all stations after 1200 MST. Visibility remained good (-25 km). The southerly winds that prevailed through 0800 MST shifted to SE-NE, reaching 17 km·h^{-1} briefly at 1600 MST.

Surface and upper air conditions were controlled by the passage of the weak ridge of high pressure mentioned in Episode 1 (see figures 14 and 19). The increased cloudiness and surface wind shift were the result of an encroaching cyclonic disturbance. That influence is also seen in the trajectory ending at EDMU at 20/1100 MST (Figure 17).

4.6.1.3.3 Case 3, Episode 3, 1983 June 30. The PAN record for Episode 3 (Figure 12) is characterized by an irregular series of peaks occurring at night. Concentrations maxima were 1.01 ppb (30/0100 MST), 1.18 ppb (30/0300 MST), and 0.99 ppb (30/0530 MST). Although not exceedingly high, these values are about three times the magnitude of the PAN concentrations that occurred at the same time the two previous nights (Figure 12). For discussion purposes, Episode 3 is defined as occurring between 29/1700 MST and 30/0830 MST.

Ozone showed its usual diurnal pattern, declining in the evening and rising in the morning. However, a minor peak in ozone concentration, 17 ppb, occurred concurrently with the major PAN peak of 1.18 ppb at 0300 MST. Nitrogen oxides rose to a maximum of 80 ppb at 2300 MST on June 29, and then declined to 30 ppb at 0300 MST on June 30, the time of the PAN and ozone peaks.

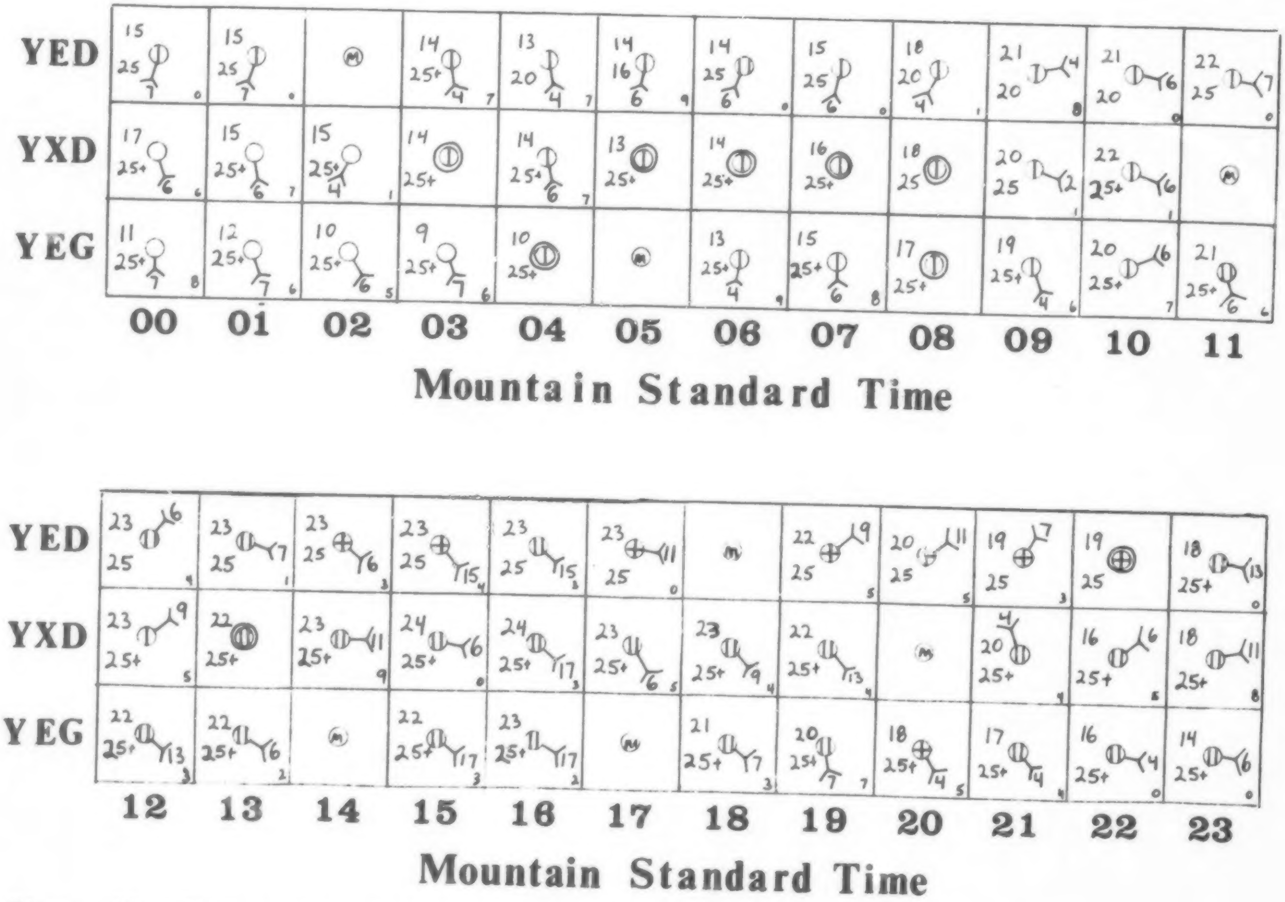

YED
YXD
YEG
00 01 02 03 04 05 06 07 08 09 10 11
Mountain Standard Time
YED
YXD
YEG
12 13 14 15 16 17 18 19 20 21 22 23
Mountain Standard Time

Figure 16. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 June 29. Case 3, Episode 2. Explanation of symbols appears in Table 2.

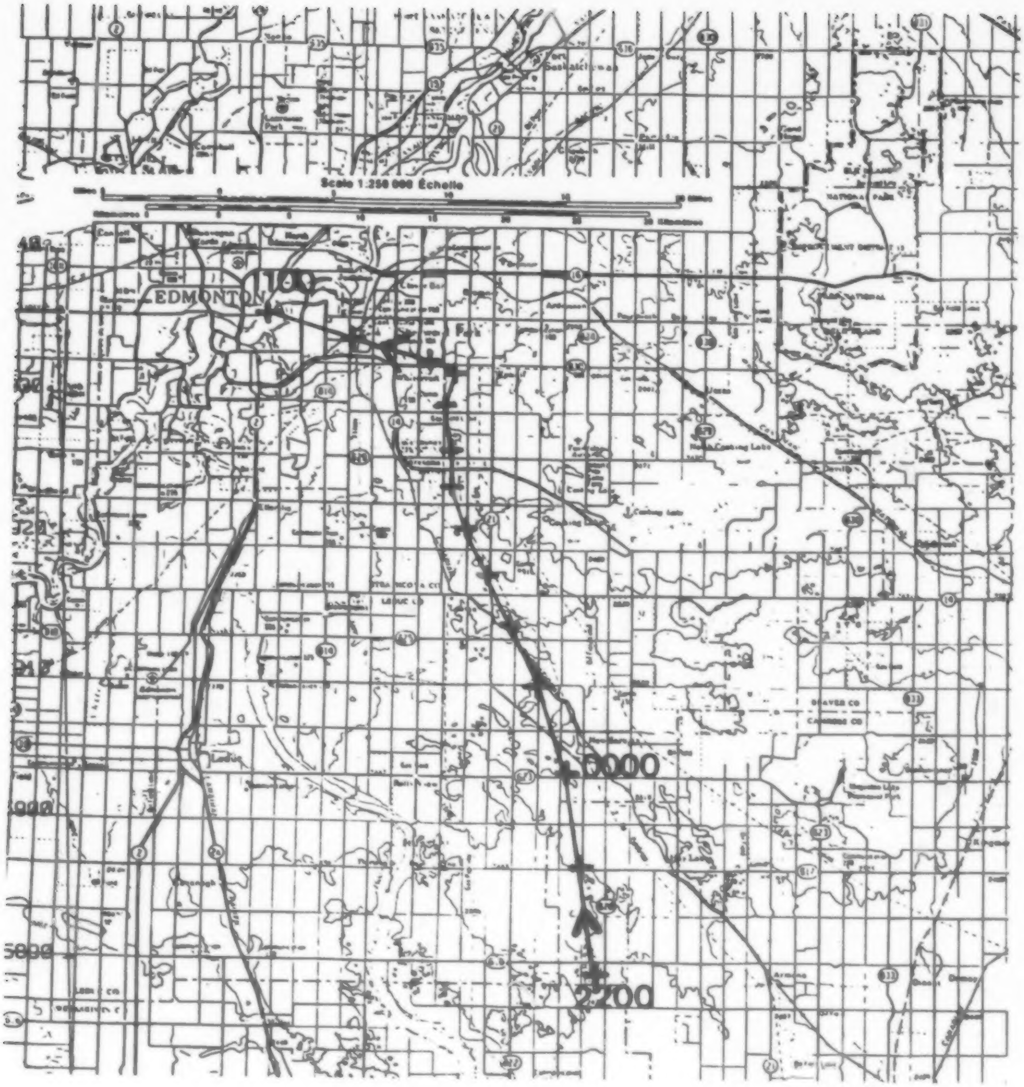

Scale 1:250 000 Échelle
EDMONTON
1100
0000
2200
Fort Saskatchewan
Leduc

Figure 17. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1030 MST, 1983 June 29. Case 3, Episode 2. Hourly portions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

As reported at the three airports in the Edmonton area (Figure 18), sky coverage was 60 to 100% and winds were generally easterly at speeds less than 22 km·h^{-1}. Conditions worsened with widespread rainshowers over the area after 30/1000 MST. Visibility remained greater than 25 km at YEG and YXD, while YED was slightly less than 25 km near sunrise, with haze reported at 30/0500 MST. The Edmonton heat island was diminished somewhat due to the prevailing cloudiness. The maximum YXD-YEG temperature difference was 4C^{o} at 29/2300 MST. The minimum temperature during the period was 13°C (at YEG). As would be expected, a combination of the Stony Plain radiosonde and the Edmonton temperatures indicated that mixing depths were very low.

Large-scale meteorological patterns (Figure 19) revealed that the ridge that had dominated central Alberta at the surface and aloft on the previous two days had moved eastward and a NW-SE oriented trough lay just south of Edmonton. Flow affecting that location was clearly east or southeast through a deep layer. The trajectory that terminated at Edmonton near the time of the PAN extreme (30/0300 MST) reflects these conditions (Figure 20). Trajectories (not shown) were also computed for secondary peaks (Figure 12, 30/0100 MST, 30/0530 MST) to determine if any significant differences existed. Aside from a tendency for the earlier trajectory (at EDMU at 30/0100 MST) to arrive from the northeast, no large differences were observed.

4.6.1.4 Case 4, 1983 July 25. Half-hourly PAN measurements for July 25 (Figure 21) exceeded 0.5 ppb for an eight-hour period (25/1030 MST to 25/1830 MST). A single major peak (3.47 ppb) occurred at 25/1300 MST. The record is slightly skewed, with a relatively rapid rise followed by a slow decrease in concentration.

Ozone showed a typical diurnal variation, rising from 1 ppb in the early morning to a maximum of 34 ppb at 1300 MST followed by a gradual decline. The maximum ozone concentration coincided with the maximum PAN concentration. Nitrogen oxides increased to 120 ppb at 0800 MST, declined to 70 ppb at 0900 MST, increased to 100 ppb at 1100 MST, and then declined to 40 ppb at 1500 MST. It was during this

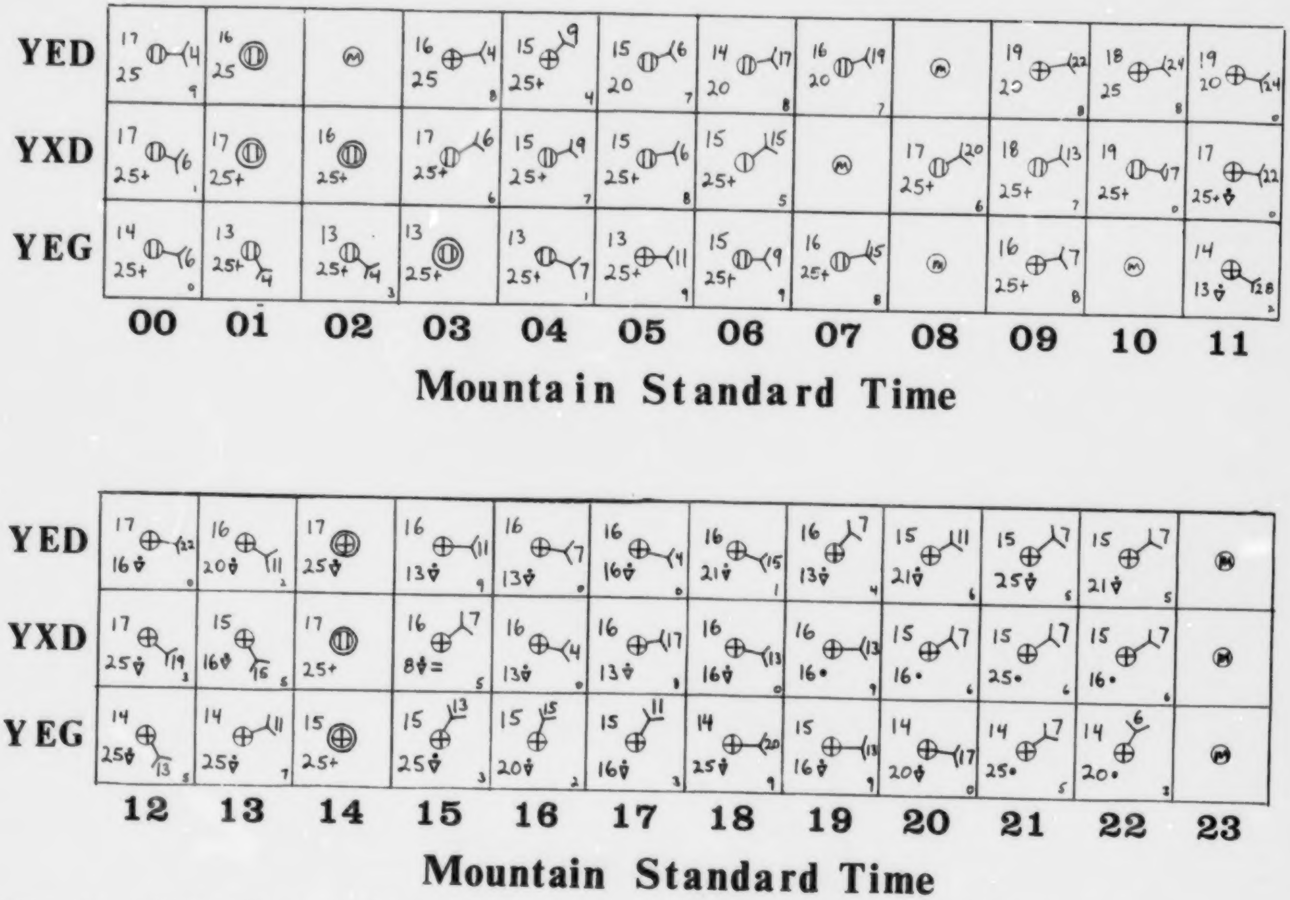


Figure 18. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 June 30. Case 3, Episode 3. Explanation of symbols appears in Table 2.

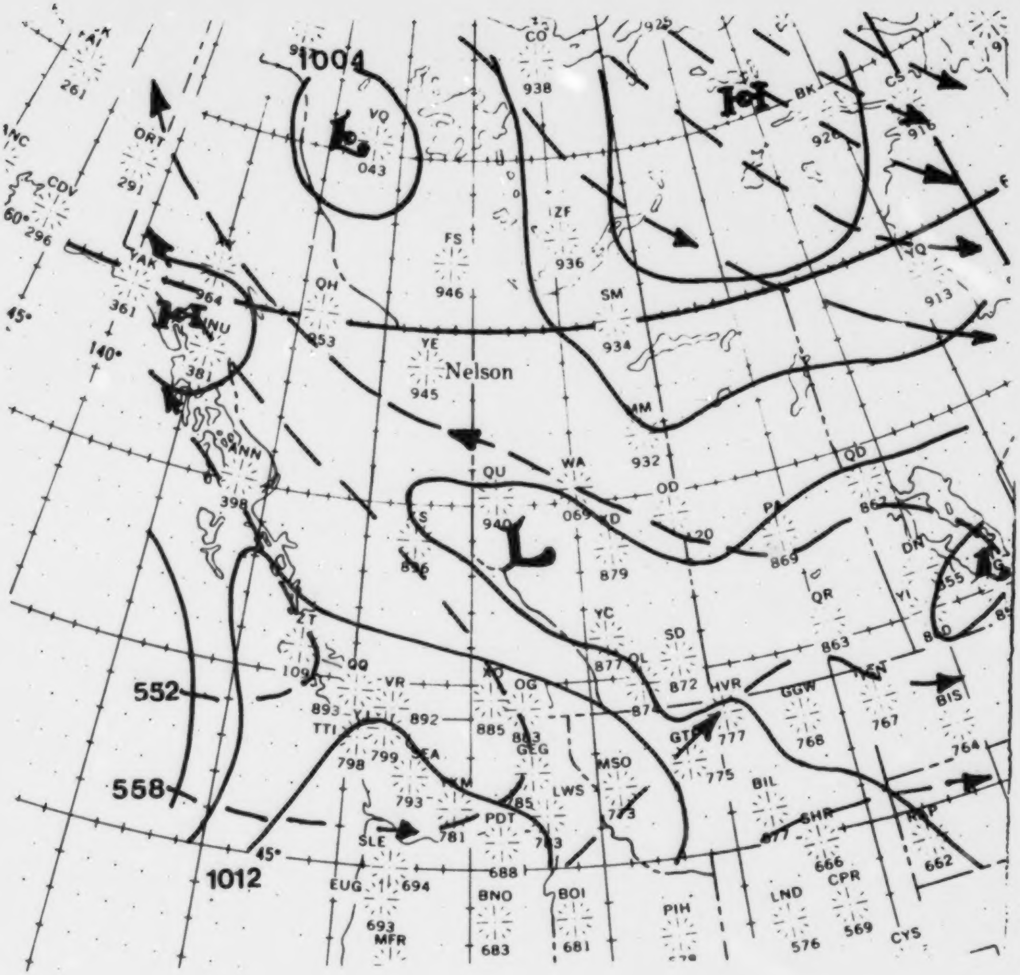

1004
VQ
043
CO
938
BK
926
CS
916
ORT
291
CDV
296
60°
YAK
361
964
ANU
381
45°
140°
FS
946
ZF
936
SM
934
YQ
913
QH
853
YE
Nelson
945
WA
069
MM
932
QU
940
OD
QD
867
ANN
398
879
869
QR
863
YC
SD
872
877
HVR
GGW
768
767
BIS
764
552
558
VR
892
893
TTI
798
799
SEA
793
OG
885
GEG
LWS
MSO
773
GTF
777
775
BIL
SHR
677
666
CPR
662
PDT
688
781
SLE
1012
EUG
694
693
MFR
BNO
683
BOI
681
PIH
LND
576
569
CYS

Figure 19. Composite surface and 500 mb analysis for 1983 June 30 at 0500 MST. Case 3, Episode 3. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

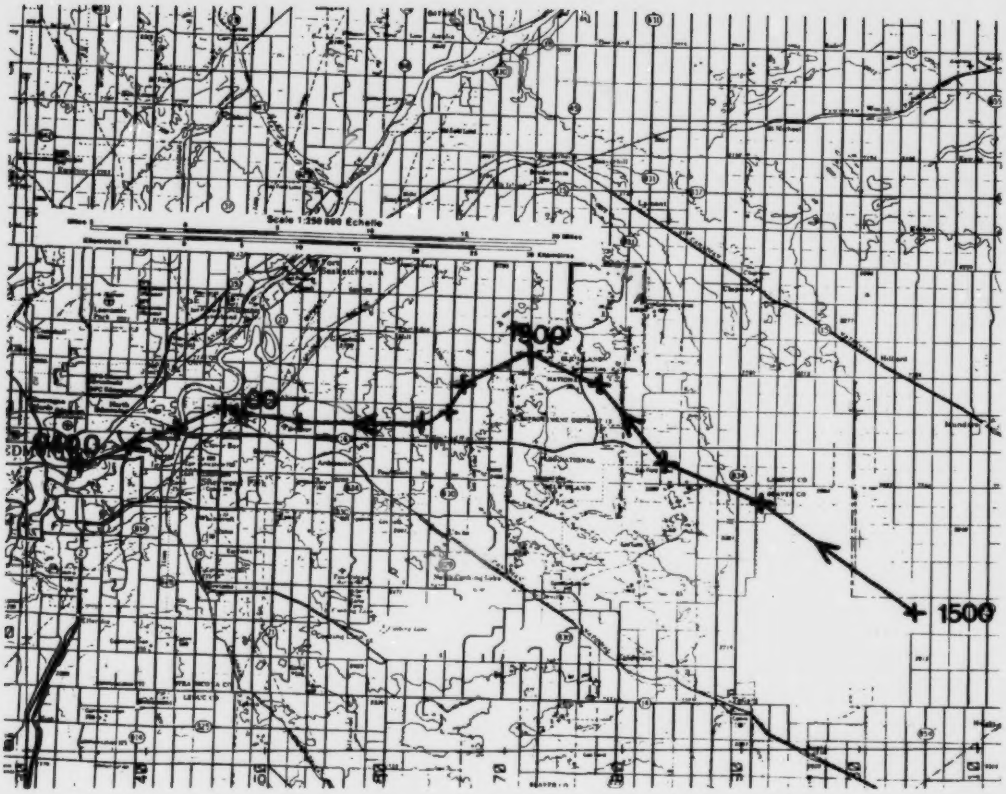

Scale 1:250 000 Echelle
1500
1900
0300

Figure 20. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 0330 MST, 1983 June 30. Case 3, Episode 3. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

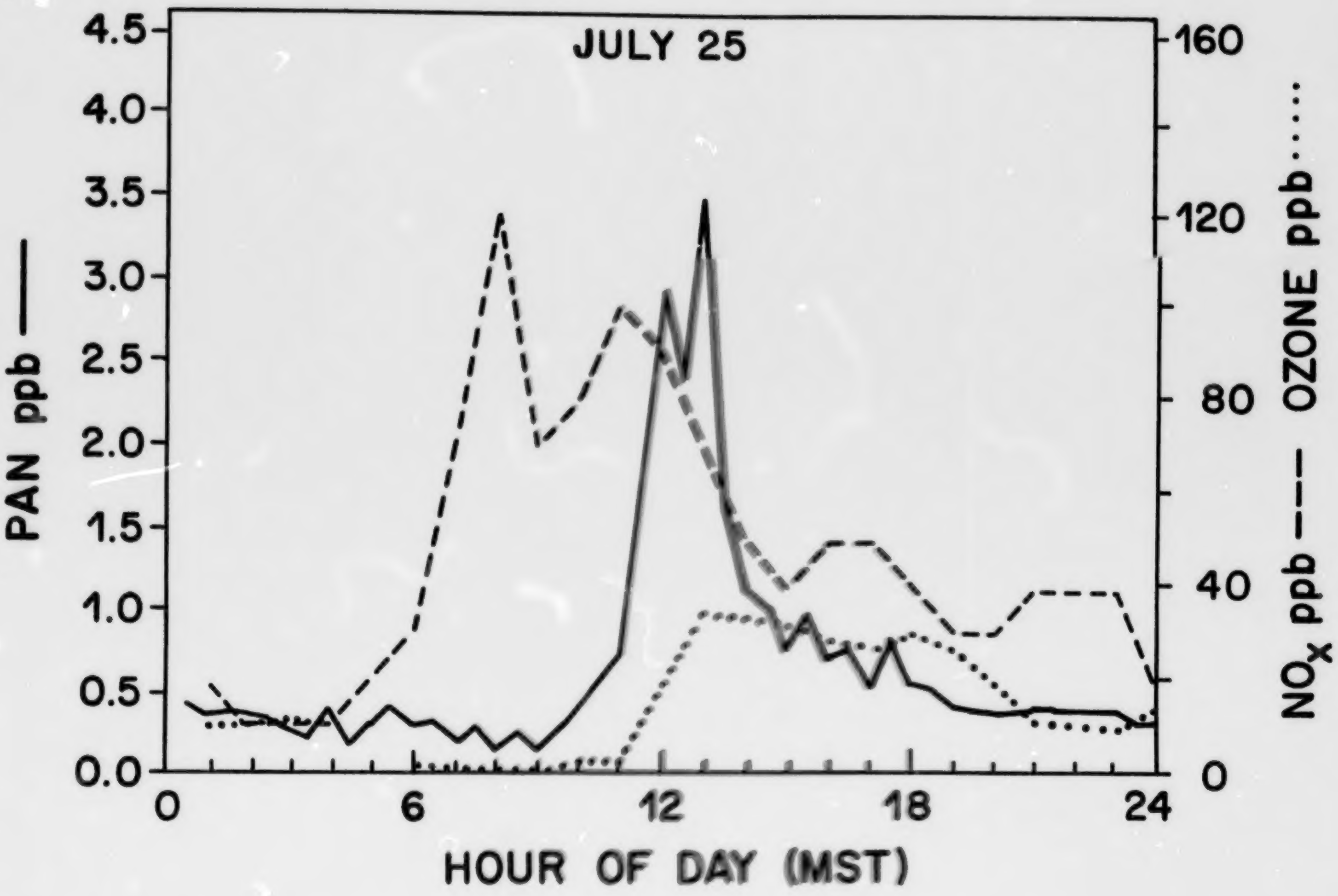


Figure 21. PAN, ozone, and NO_x concentrations in Edmonton, 1983 July 25. Case 4.

latter period of nitrogen oxide decline that both PAN and ozone reached maximum concentrations.

PAN measurements were also made at Ellerslie on this date (Figure 22, Table 7). The maximum PAN concentration was 0.44 ppb recorded at 1600 MST, somewhat later than the major PAN peak of 3.47 ppb recorded at 1300 MST in Edmonton. Ozone concentrations were higher at Ellerslie and in Edmonton, probably reflecting the suppression of ozone by nitrogen oxides in the more polluted Edmonton atmosphere. At Ellerslie, the maximum ozone concentration of 54 ppb occurred at 1800 MST, which was later in the day than it had in Edmonton.

Weather conditions at the three Edmonton airports (Figure 23) were dominated by light winds, drizzle, and low visibility in fog and haze, especially in the early morning hours. The time of the rapid increase in PAN corresponded well with the decrease in fog and low clouds after 25/0900 MST, although multi-layered middle and high clouds persisted above (60 to 90% coverage). By 25/1600 MST, visibility was greater than 25 km at all three airports and light (9 km$\cdot$h^{-1}) southeasterly winds were evident. The Stony Plain sounding indicated that during the day maximum mixing depths over Edmonton were in the range of 960 m to 1360 m. Maximum temperatures were near 24^{o}C, while minima reached 15^{o}C (at YEG). The urban heat island was weak, evidently due to the extensive cloudiness (maximum YXD-YEG temperature difference was 2C^{o}).

The large-scale synoptic conditions (Figure 24) were dominated by a trough along the west coast in the mid- and upper-troposphere, with generally southwesterly flow across central and southern Alberta. Winds at 500 mb at Edmonton indicated that the upper ridge line crossed the area between 25/0500 MST and 25/1700 MST.

At the surface, a TROWAL (trough of warm air aloft) was located in eastern Saskatchewan (Figure 24). This feature had brought precipitation to the Edmonton area the day before and left a generally weak pressure gradient (low wind speeds) in its wake. The combination of the high surface moisture and weak winds was conducive to the formation of the fog and low clouds leading to the low visibility discussed earlier. The surface trajectory that terminated at EDMU at

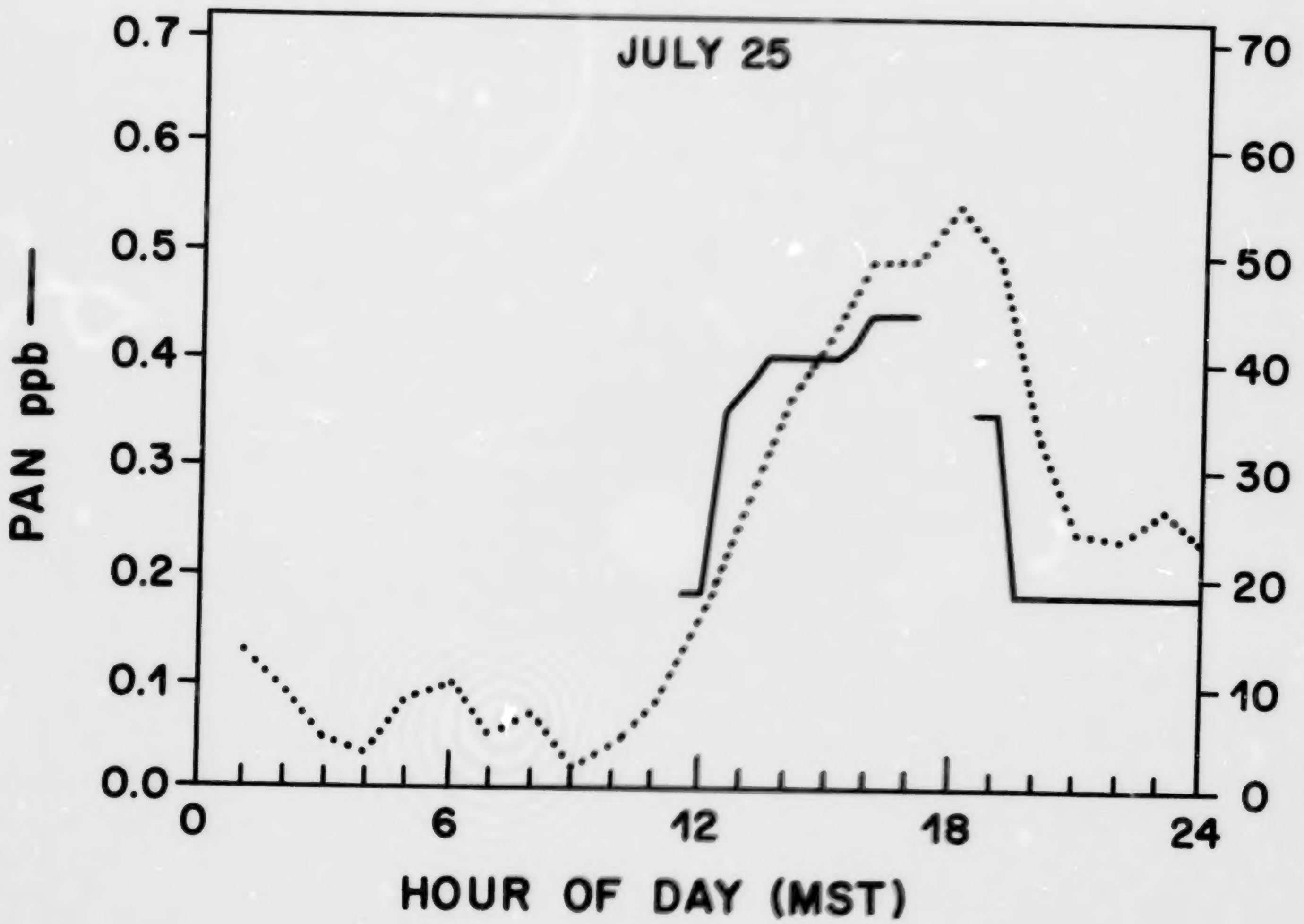


Figure 22. PAN and ozone concentrations in Ellerslie, 1983 July 25. Case 4.

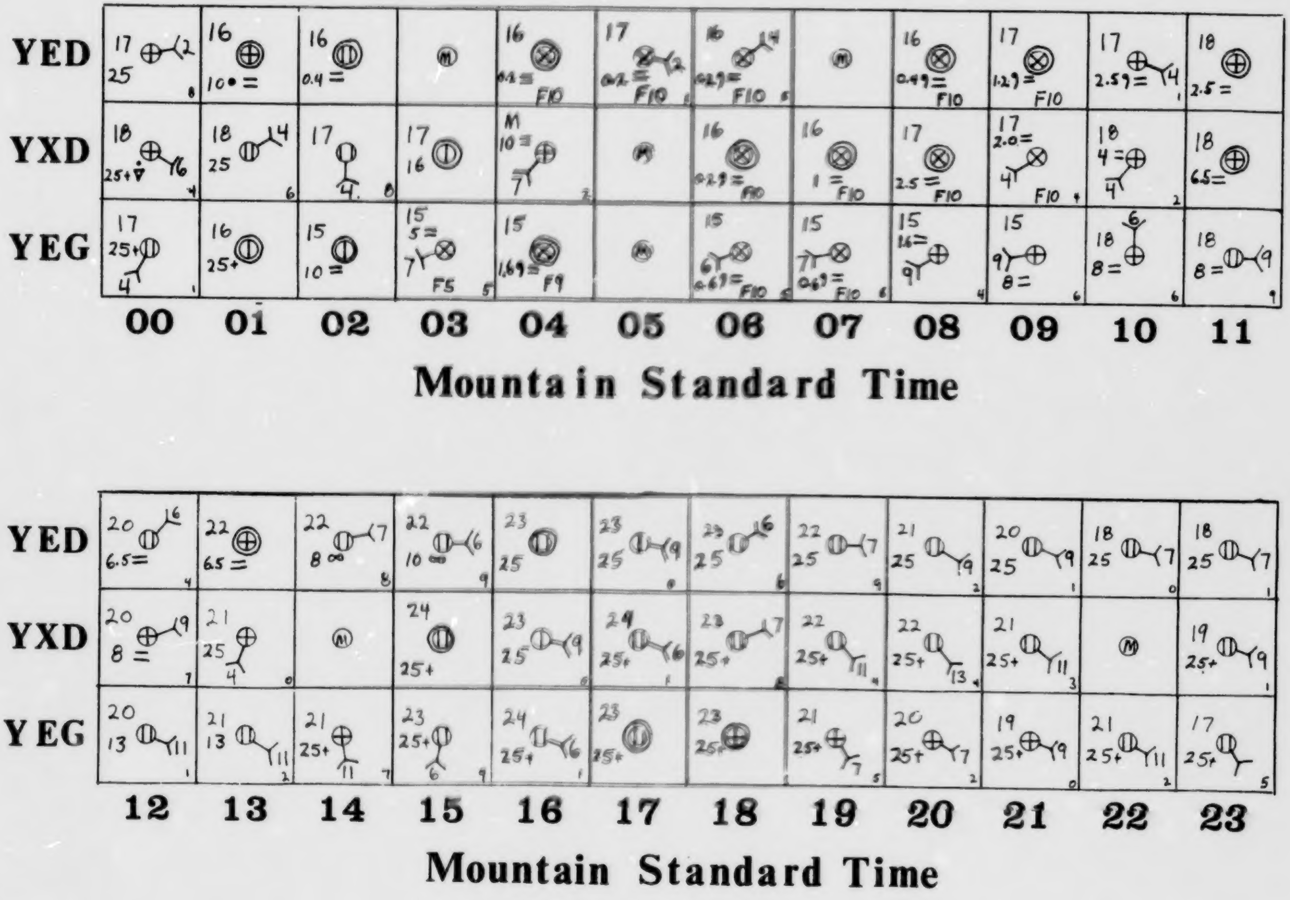

YED
YXD
YEG
00
01
02
03
04
05
06
07
08
09
10
11
Mountain Standard Time
YED
YXD
YEG
12
13
14
15
16
17
18
19
20
21
22
23
Mountain Standard Time

Figure 23. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 July 25. Case 4. Explanation of symbols appears in Table 2.

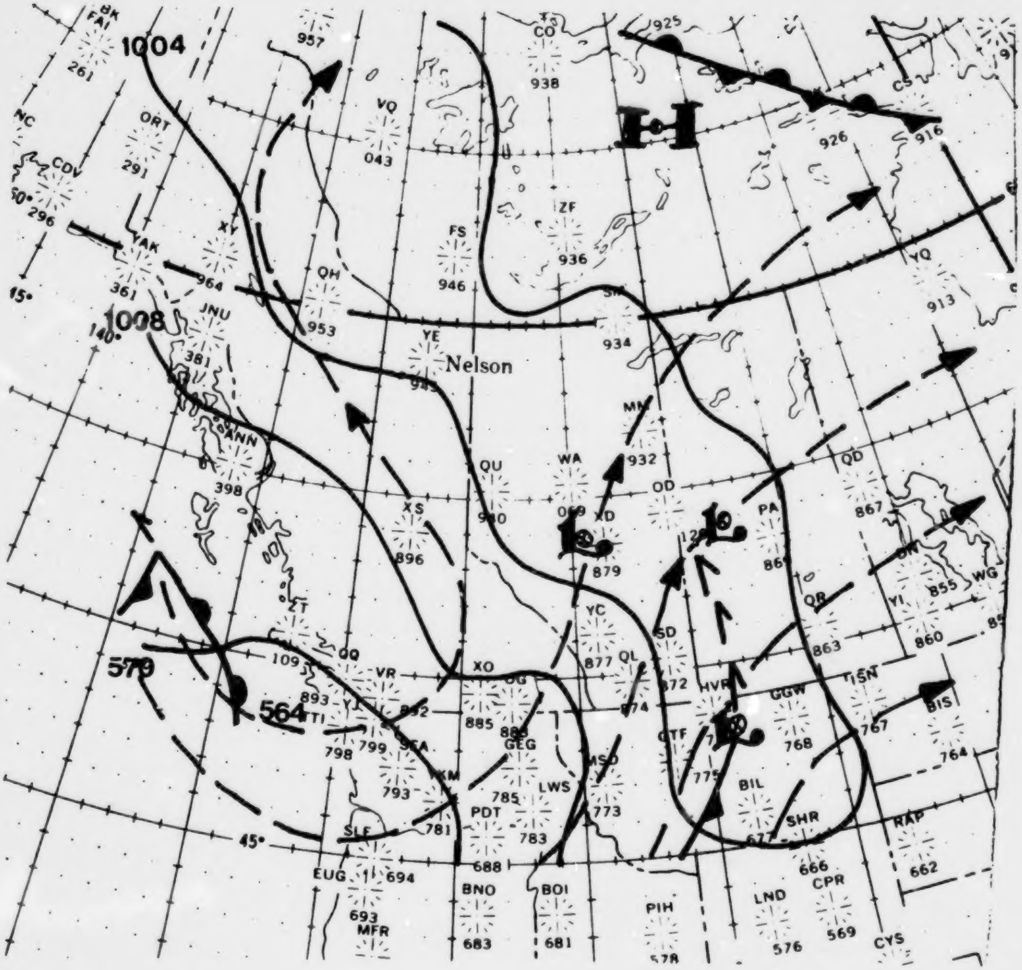

1004
1008
579
564
Nelson
45°
50°
140°
H
L
957
938
925
916
926
913
043
946
936
934
953
945
932
879
867
896
855
860
863
872
877
874
885
893
892
798
799
793
781
785
783
773
768
764
767
775
677
666
662
694
693
688
683
681
576
569
261
291
296
361
381
398
364
FAI
NC
CDV
ORT
YAK
XY
JNU
ANN
QH
VQ
FS
YE
ZF
CO
CS
YQ
QU
WA
XD
OD
MM
PA
QD
WG
XS
ZT
QQ
VR
XO
GEG
LWS
PDT
SEA
PKM
SLE
EUG
MFR
BNO
BOI
PIH
LND
CPR
CYS
RAP
SHR
BIL
GTF
MSO
HVR
GGW
ISN
BIS
QR
YC
QL
SD
TTI

Figure 24. Composite surface and 500 mb analysis for 1983 July 25 at 1700 MST. Case 4. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

25/1300 MST (Figure 25) illustrates the effect of the weak, southeasterly flow that persisted after 25/0000 MST. The trajectory indicates that the PAN detected at Ellerslie did not originate in Edmonton.

4.6.1.5 Case 5, 1983 August 02 to 05. Case 5 is composed of four PAN episodes, each occurring on successive days (Figures 26 and 34). Episodes on August 2, 4, and 5 were quite similar in the characteristic asymmetric shape in the record of half-hour measurements; in contrast, the August 3 record shows a gradual increase and a rapid decline. Large-scale meteorological conditions were controlled by a series of rapidly moving upper level disturbances embedded in generally southwesterly flow aloft.

4.6.1.5.1 Case 5, Episode 1, 1983 August 02. The PAN concentration in Edmonton on 1983 August 02 rose abruptly to values 0.50 ppb after 02/0800 MST (Figure 26). Thereafter, the PAN concentration decreased to about 2.0 ppb when an instrument malfunction occurred. Case 5 is identified as the period 01/0800 MST to 02/1230 MST.

During the period when PAN was increasing in concentration, ozone was also increasing and nitrogen oxides were declining. Ozone continued to increase after the PAN maximum was reached.

At Ellerslie on August 2, PAN concentrations reached a maximum of 0.85 ppb at 1130 MST and remained at this relatively high concentration for four hours (Figure 27, Table 7). Ozone concentrations rose to a peak concentration of 66 ppb later in the day at 1800 MST. This compares with a maximum ozone concentration in Edmonton of 54 ppb, which occurred at 1300 MST. As was the case in Edmonton, the maximum PAN concentration was reached prior to the ozone maximum.

The early morning hours of 1983 August 02 (Figure 28) were characterized by scattered clouds (>50% coverage), good visibility ($\geq$25 km), and light northerly surface winds (>7 km$\cdot$h^{-1}). A heat island was established over the city (YXD-YEG temperature difference was 5C^{o} at 02/0200 MST). At 02/0600 MST, visibility decreased at YED and YEG due to haze and ground fog for a few hours. Winds veered to easterly-east when the PAN episode occurred at EDMU.

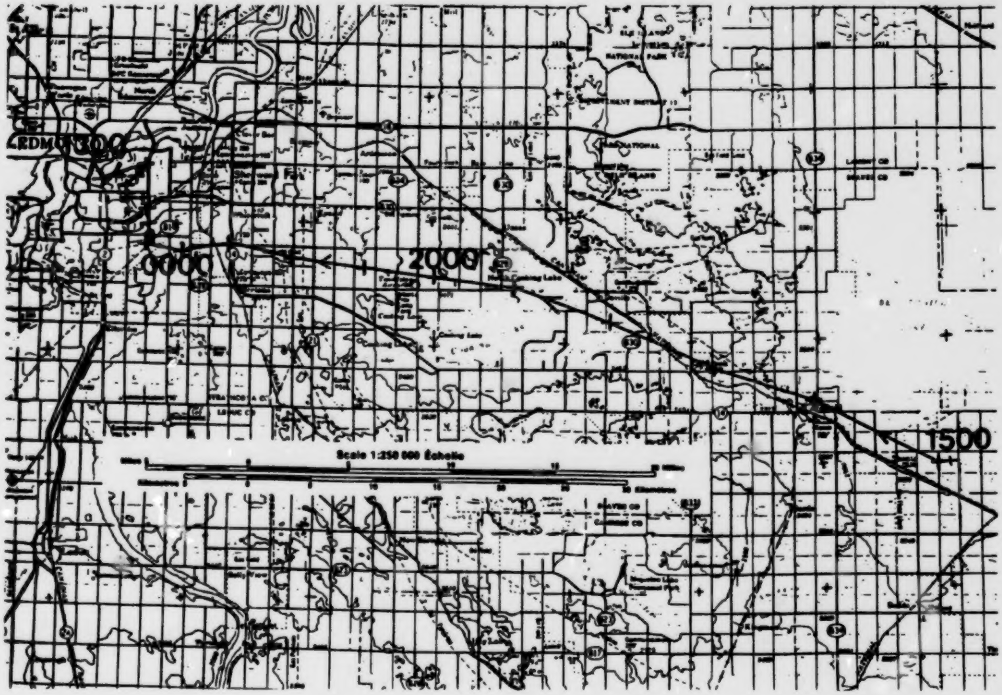

1300
0000
2000
1500
Scale 1:250 000 Échelle

Figure 25. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1300 MST, 1983 July 25. Case 4. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

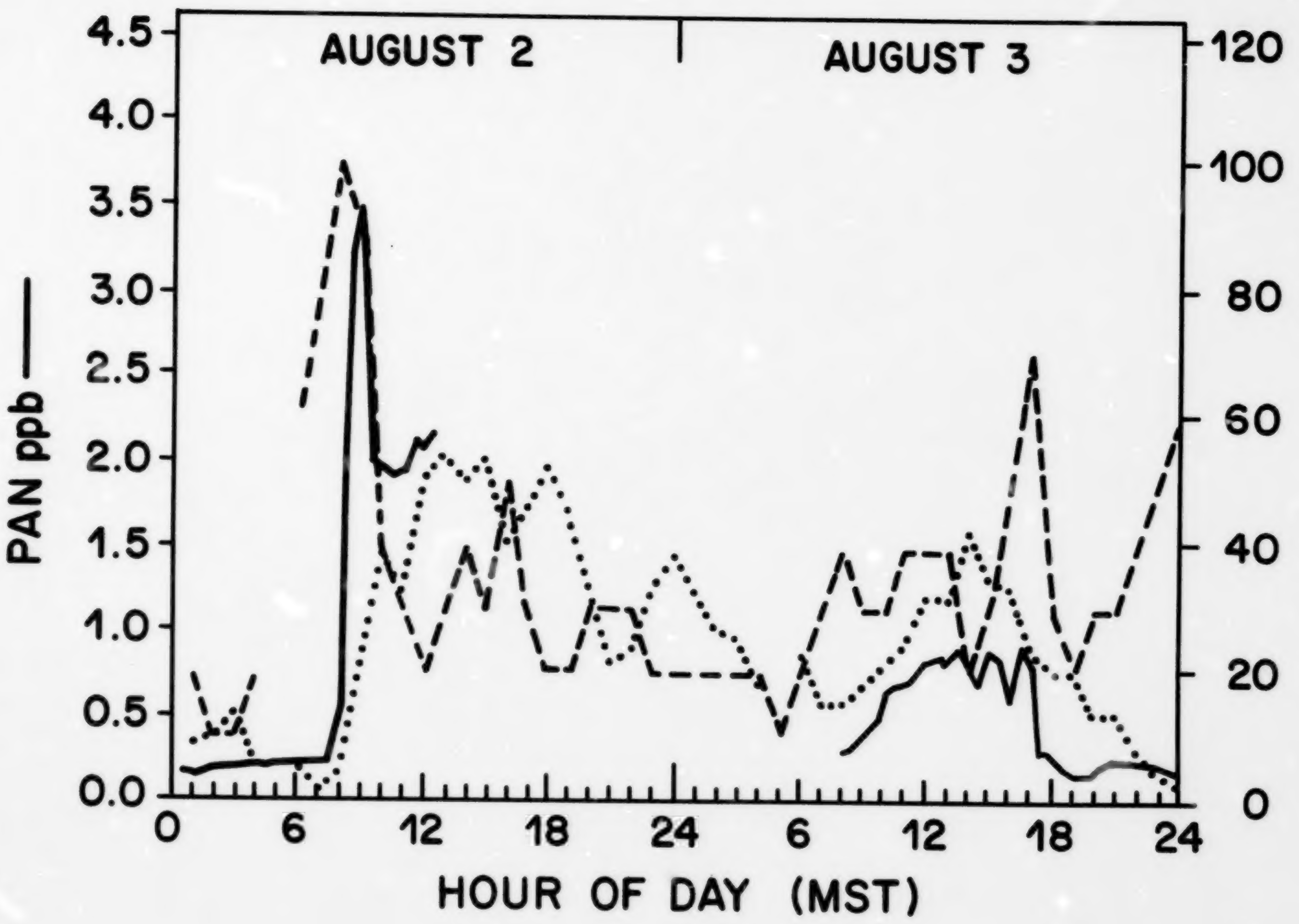


Figure 26. PAN, ozone, and NO$_x$ concentrations in Edmonton, 1983 August 02 and 03. Case 5, episodes 1 and 2.

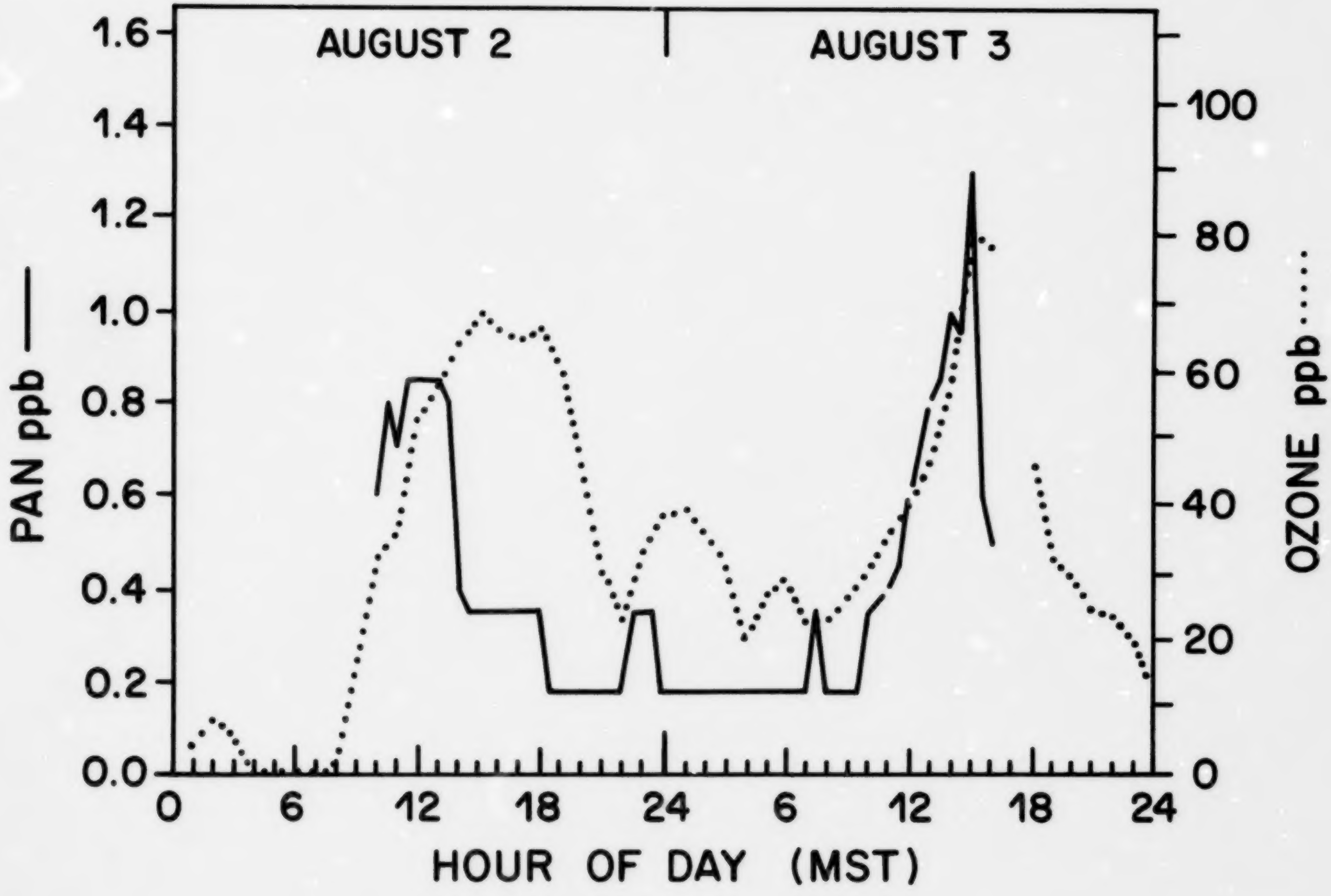


Figure 27. PAN and ozone concentrations in Ellerslie, 1983 August 02 and 03. Case 5, episodes 1 and 2.

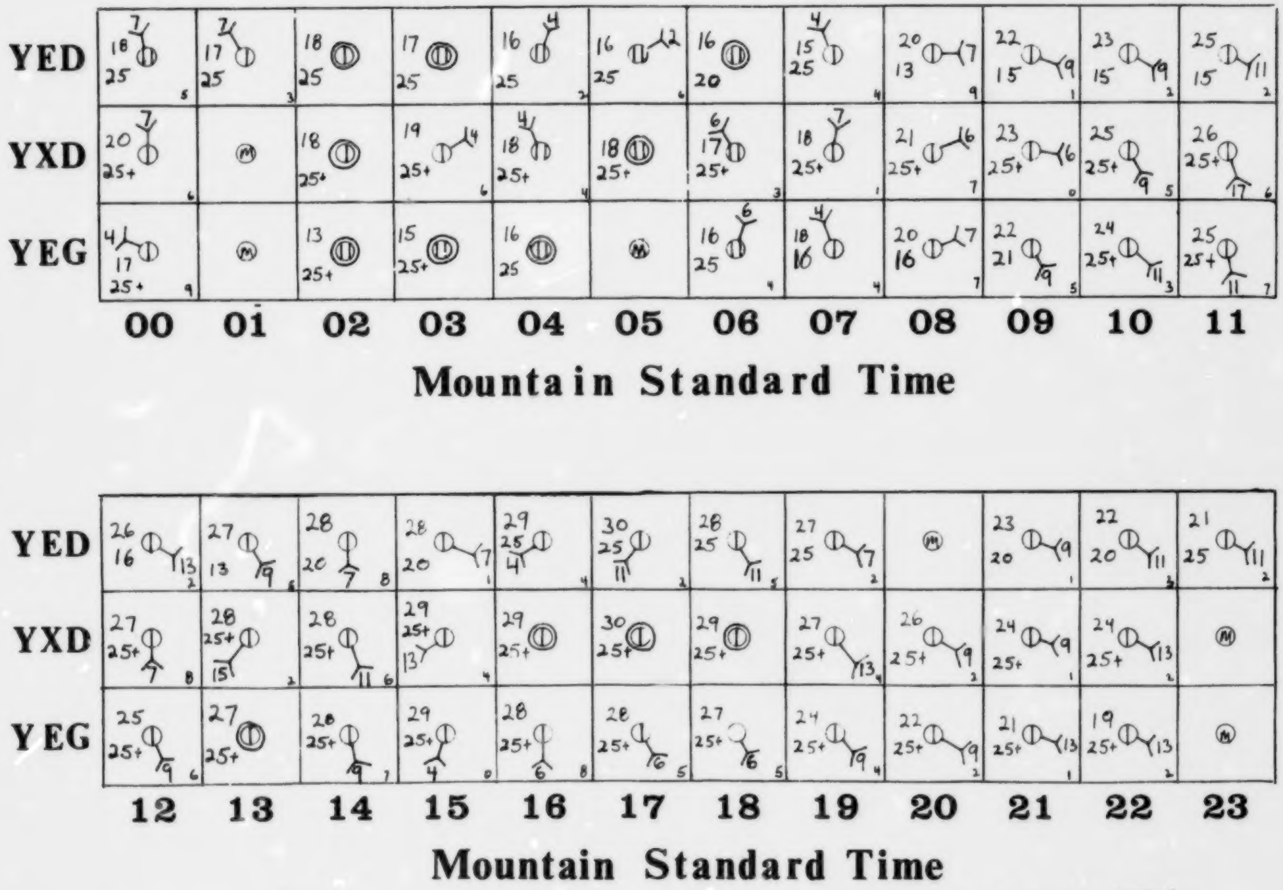

YED
YXD
YEG
00 01 02 03 04 05 06 07 08 09 10 11
Mountain Standard Time
YED
YXD
YEG
12 13 14 15 16 17 18 19 20 21 22 23
Mountain Standard Time

Figure 28. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 02. Case 5, Episode 1. Explanation of symbols appears in Table 2.

Cumulus cloud base heights indicated that mixing depths increased from about 800 m at 02/1100 MST to nearly 1400 m by 1400 MST. This is in good agreement with the Stony Plain radiosonde.

The synoptic conditions presented in Figure 29 show that a weak ridge existed in the sea level pressure field just west of Edmonton at 02/0500 MST. That feature moved slowly eastward, evidently contributing to the shift in surface winds from northerly to easterly (at the time of the PAN maximum) and finally to southerly. Aloft, a related short wave ridge embedded in predominantly southwesterly flow crossed the study area just after 02/0500 MST.

The trajectory that terminated at Edmonton at the time of the PAN maximum is shown in Figure 30. It originated about 35 km to the north 12 hours earlier, subsequently arriving from the east side of the city as the winds veered to easterly. Pollutants from Edmonton were likely the source of the PAN detected at Ellerslie.

4.6.1.5.2 Case 5, Episode 2, 1983 August 03. Half-hour PAN measurements for Edmonton (Figure 26) were missing until 03/0800 MST. Thereafter, concentrations increased gradually to a series of three peaks at 1300 MST, 1500 MST, and 1630 MST. The latter concentration was the greatest (0.92 ppb). PAN concentrations fell rapidly to values less than 0.5 ppb after 03/1700 MST.

The trend in ozone concentrations followed that of the PAN, reaching a maximum of 42 ppb at 1400 MST. Ozone declined in the late afternoon as the nitrogen oxides increased. PAN concentrations remained relatively high and did not decline after the concentration of nitrogen oxides declined at 1700 MST.

PAN concentrations at Ellerslie reached a maximum of 1.30 ppb at 1500 MST (Figure 27), corresponding to one of the peaks in the Edmonton PAN concentrations. Ozone at Ellerslie also reached a maximum at 1500 MST. The 80 ppb level recorded at Ellerslie was considerably higher than the 42 ppb measured in Edmonton. These higher concentrations may result from the generation of ozone downwind of Edmonton or the suppression of ozone by nitrogen oxides within the city.

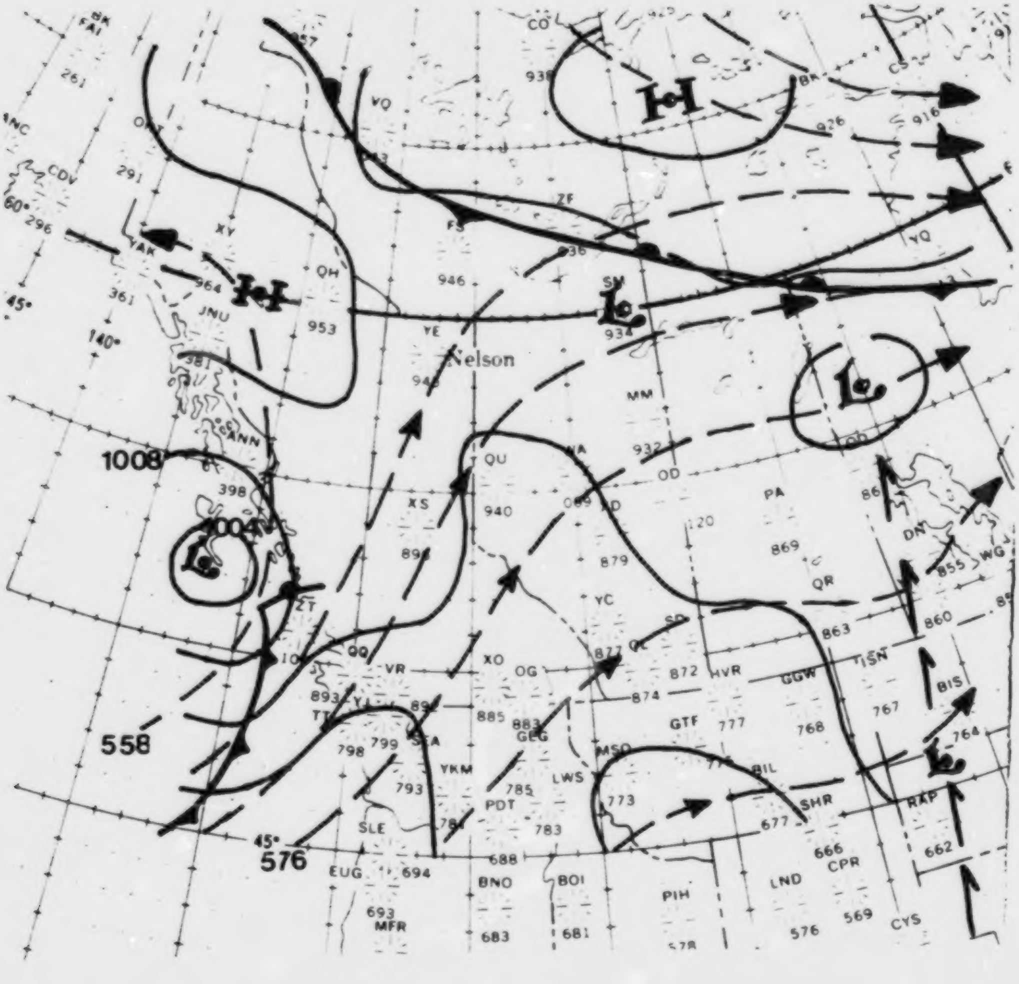


Figure 29. Composite surface and 500 mb analysis for 1983 August 02 at 0500 MST. Case 5, Episode 1. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

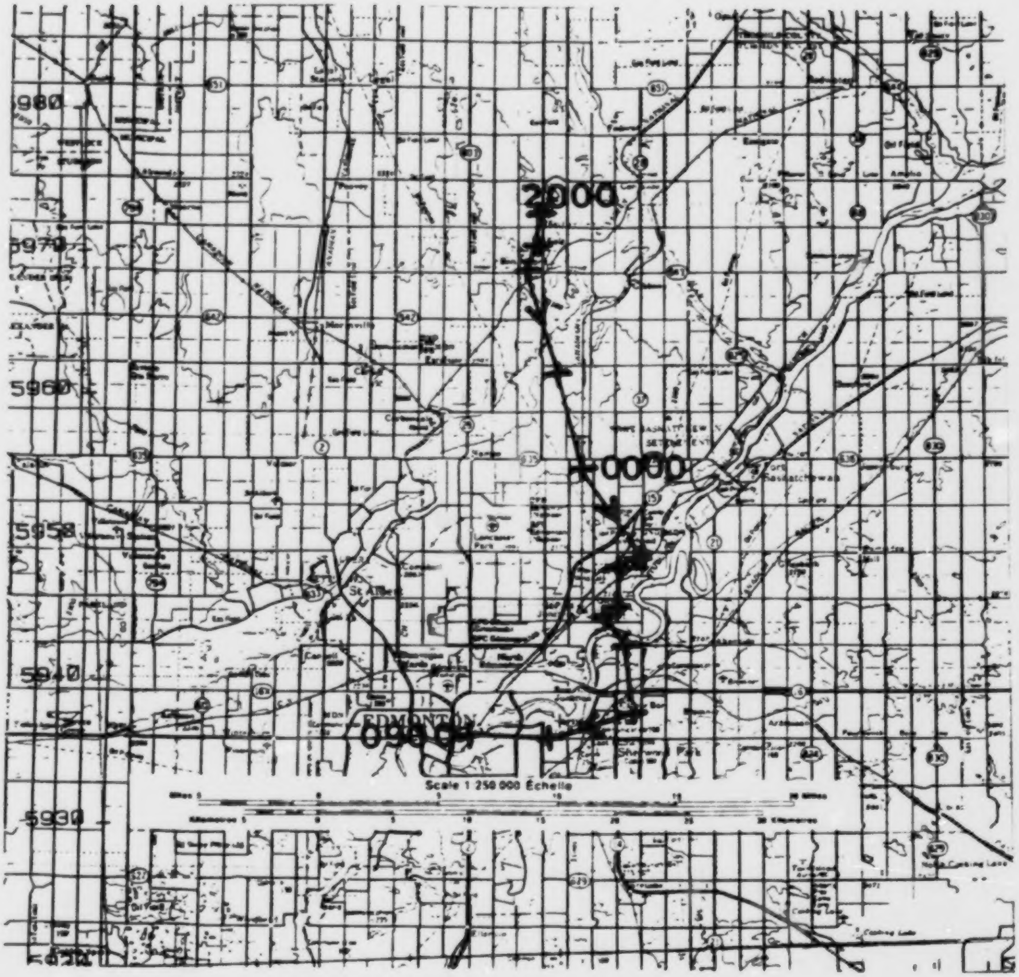

980
5970
5960
5950
5940
5930
2000
0000
0900
EDMONTON
St Albert
Fort Saskatchewan
Morinville
Scale 1:250 000 Échelle

Figure 30. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 0900 MST, 1983 August 02. Case 5, Episode 1. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

Although visibility remained good throughout the day, cloud cover gradually increased to 100% coverage due to afternoon convective activity (Figure 31). As would be expected under these conditions, mixing depths were large, exceeding 1500 m at the time of the PAN maximum.

Showers and thunderstorms occurred over the area between 1700 MST and 2100 MST. Winds were northwesterly after 0800 MST, veering to easterly by 1600 MST. With the onset of the thunderstorm activity at 1700 MST, the winds backed to northerly, reaching 33 $km \cdot h^{-1}$.

Large-scale meteorological conditions valid for the afternoon of 1983 August 3 are shown in Figure 32. The fair weather sea level pressure ridge of the previous day had moved eastward, giving way to a cold frontal passage through the Edmonton area. The post cold frontal convective activity described above was supported by a subtle upper level disturbance travelling northeastward in the broad southwesterly current at 500 mb. The convective activity was evidently the cause of the surface wind shift and sudden decrease in PAN after 1700 MST. The brisk winds and strong mixing homogenized temperature over the urban area, reducing the heat island effect.

The trajectory that terminated at EDMU at 03/1700 MST is shown in Figure 33. Post frontal northwesterly and northerly flow influenced the trajectory during the late morning and early afternoon. The erratic path of the air after 1500 MST was evidently due to thunderstorm activity.

4.6.1.5.3 Case 5, Episode 3, 1983 August 04. Half-hour PAN concentrations for Episode 3 (Figure 34) were characterized in Edmonton by a rapid increase above 0.5 ppb after 04/1130 MST to a maximum (1.63 ppb) at 1230 MST. The generally slow decrease later in the day was interrupted by a secondary maximum at 2030 MST (0.86 ppb).

Ozone concentrations on August 4 showed the usual diurnal variation rising from a minimum of 6 ppb at 0600 MST to a maximum of 38 ppb at 1400 MST. Concentrations then declined to 4 ppb at 2300 MST. Early morning NO_x concentrations rose to a maximum of 90 ppb at 0800 MST, declined, then rose to a secondary maximum of 70 ppb at 1300 MST

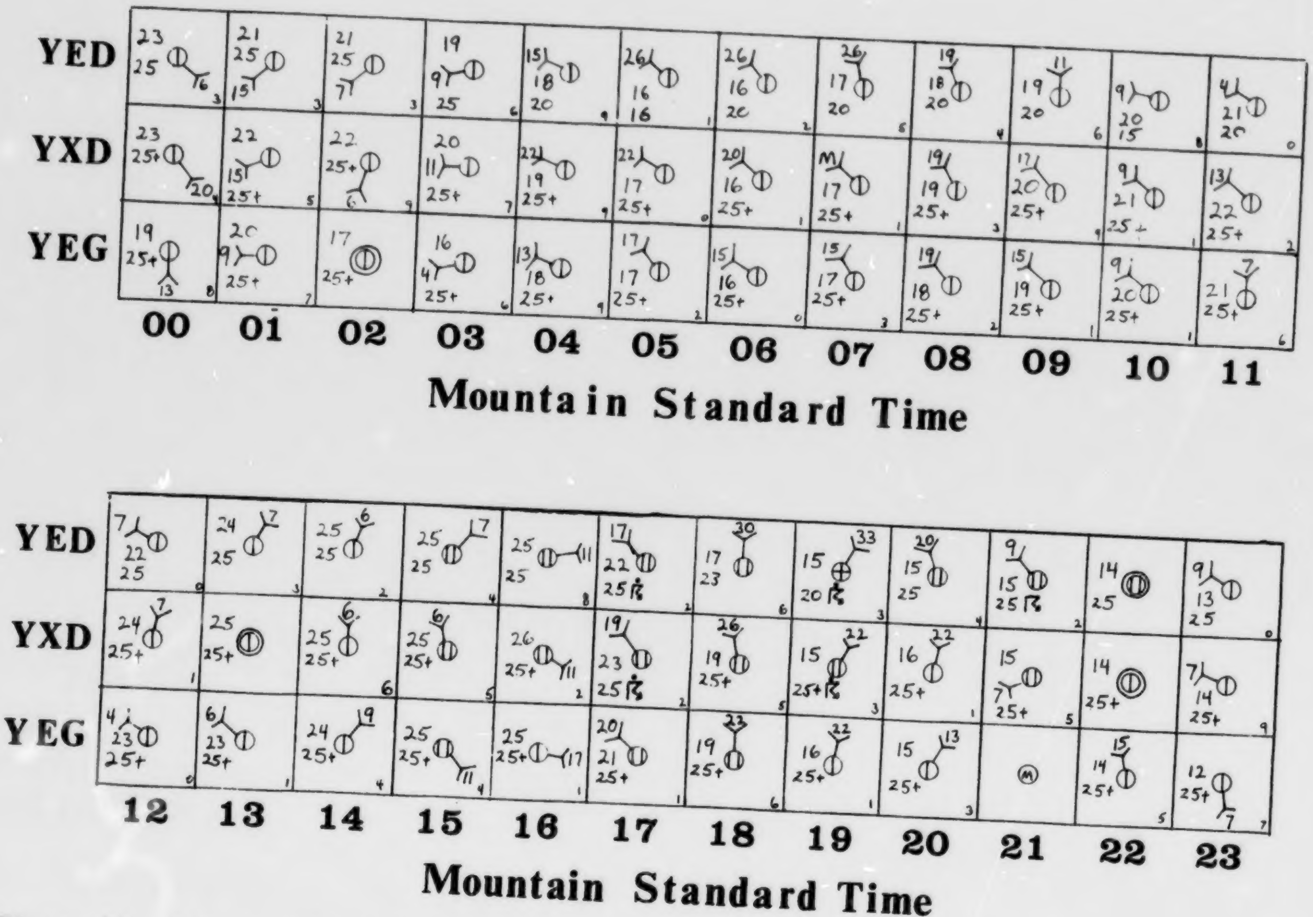


Figure 31. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 03. Case 3, Episode 2. Explanation of symbols appears in Table 2.

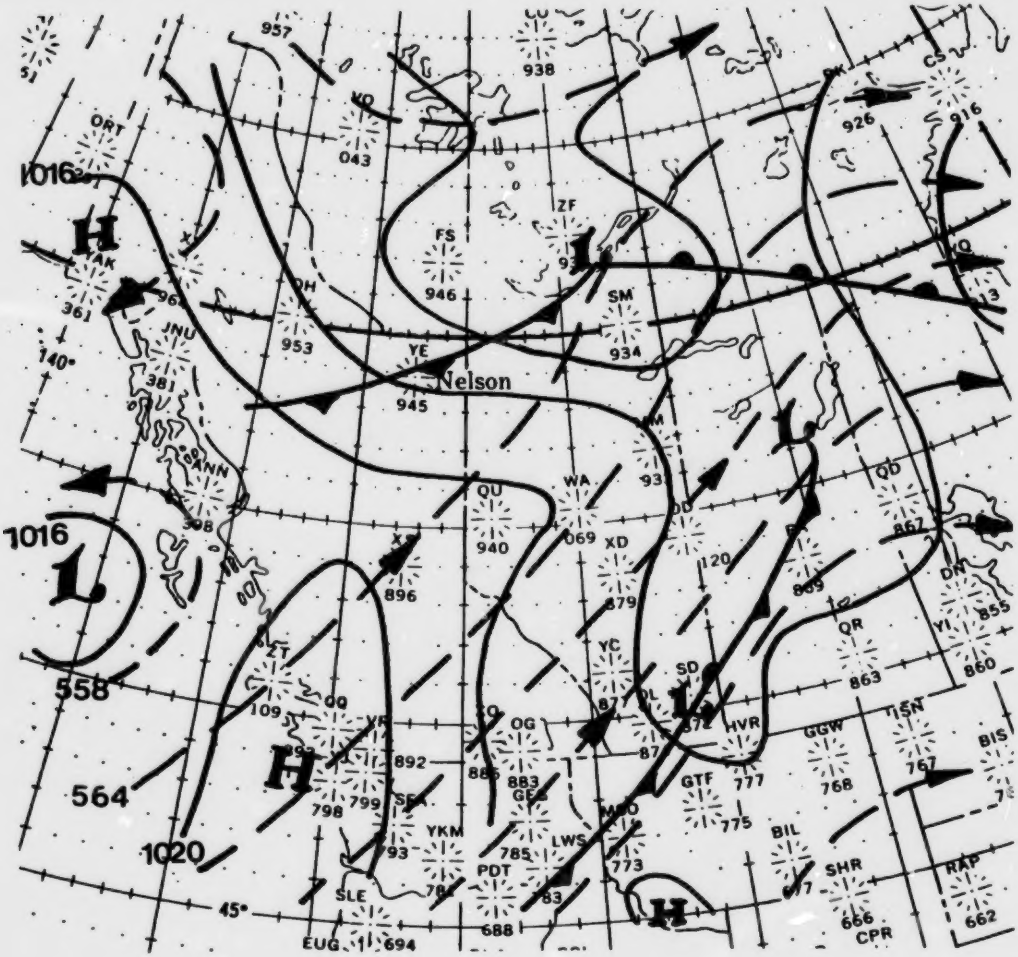

1016
H
L
1016
L
558
564
1020
H
L
L
H
140°
45°
Nelson
ORT
YAK
361
JNU
381
ANN
398
957
XD
043
938
FS
946
ZF
SM
934
953
YE
945
QU
940
WA
069
XD
879
896
ZT
109
VR
892
798
799
SEA
793
YKM
784
PDT
688
SLE
EUG
694
OG
883
785
LWS
783
YC
877
SD
872
HVR
GTF
777
775
773
BIL
SHR
666
CPR
GGW
768
ISN
767
BIS
RAP
662
QR
863
YI
860
855
867
869
926
916
CS
120

Figure 32. Composite surface and 500 mb analysis for 1983 August 03 at 1700 MST. Case 5, Episode 2. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

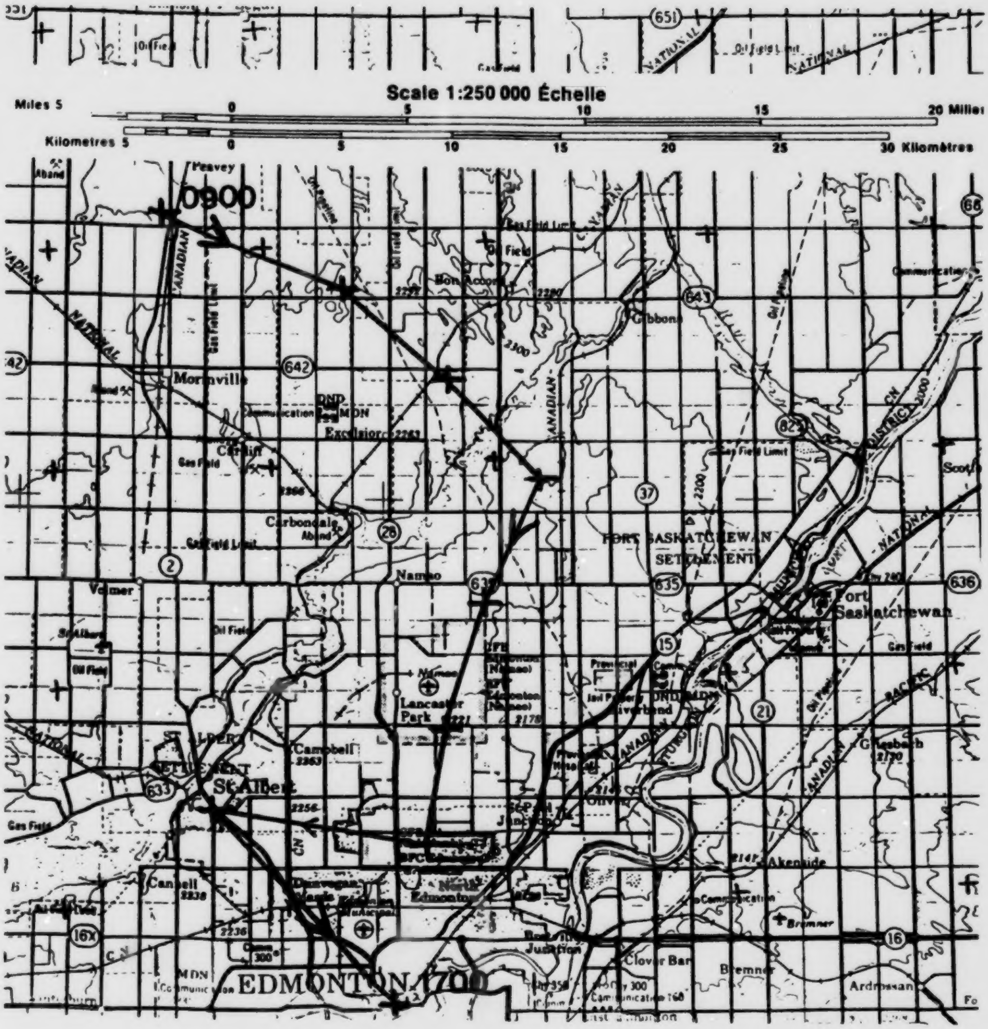

Scale 1:250 000 Échelle
Miles 5
0
5
10
15
20 Miles
Kilometres 5
0
5
10
15
20
25
30 Kilomètres
0900
1700
EDMONTON
Morinville
Bon Accord
Gibbons
Cardiff
Carbondale
Namao
Villeneuve
St. Albert
Campbell
Lancaster Park
Fort Saskatchewan
Clover Bar
Bremner
Ardrossan
Akenside
Oliver
Gibbons
Excelsior
Peavey

Figure 33. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1700 MST, 1983 August 03. Case 5, Episode 2. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

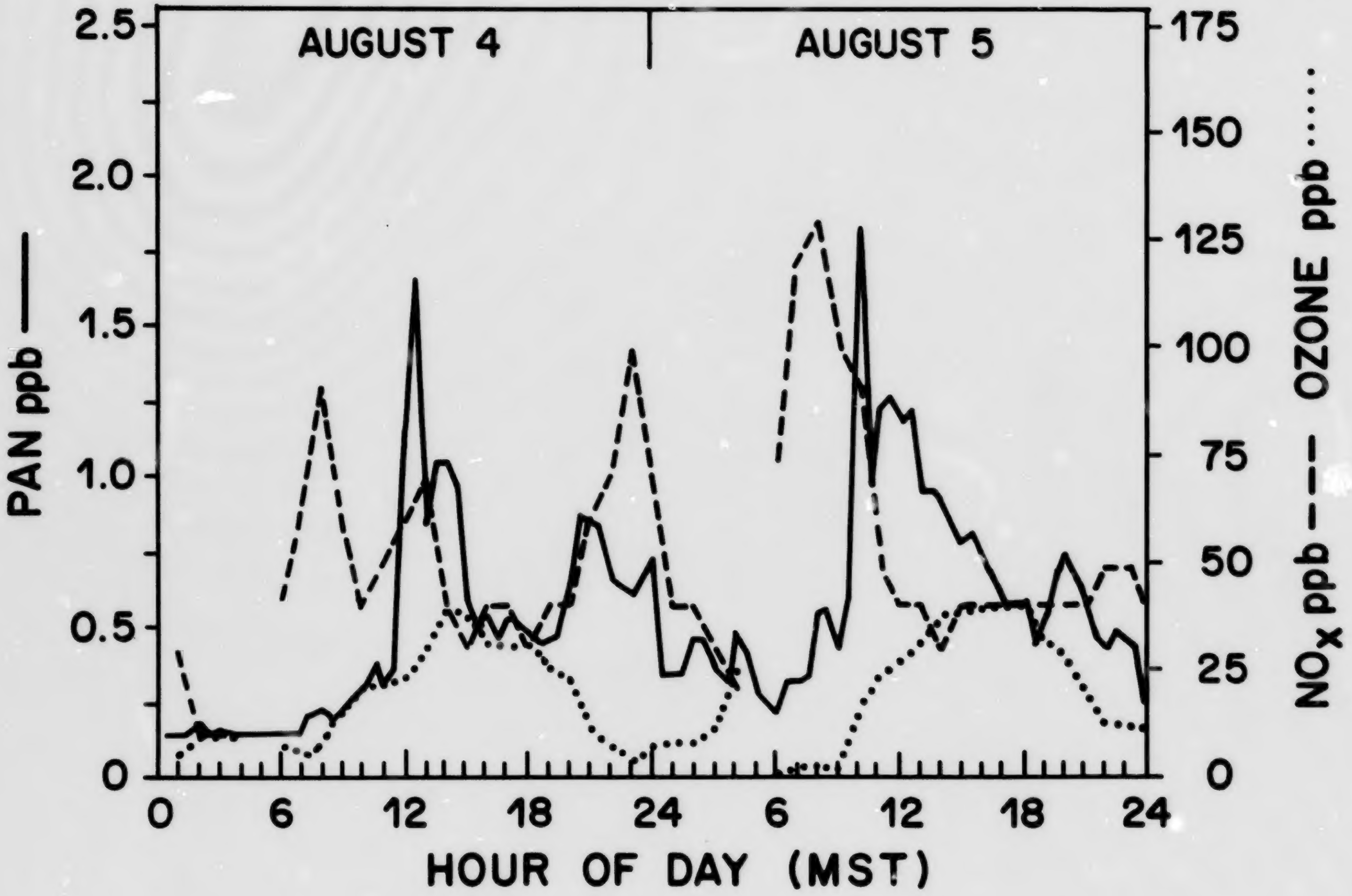


Figure 34. PAN, ozone, and NO$_x$ concentrations in Edmonton, 1983 August 04 and 05. Case 5, episodes 3 and 4.

before declining again to 30 ppb at 1400 MST. The maximum PAN concentration was reached at 1230 MST, during the period when both ozone and NO_x were increasing.

At Ellerslie, a maximum PAN concentration of 0.50 ppb was reached at 1300 MST (Figure 35), about the same time as the maximum in Edmonton. Ozone concentrations at Ellerslie reached a maximum of 55 ppb at 1200 MST, which was somewhat higher than the 38 ppb maximum reached in Edmonton later in the day.

Meteorological conditions at YED, YXD, and YEG (Figure 36) were generally marked by good visibility and sky cover of 50% or less. The heights of the fair weather cumulus clouds observed at YED near the time of the PAN maximum indicate mixing depths exceeded 1300 m AGL.

The major change in surface weather was a shift in wind direction from northwesterly before noon to southeasterly or easterly after noon. Temperatures varied from a morning minimum of 9°C at YEG to an afternoon maximum of 23°C at YXD. The heat island was only weakly defined on the evening of August 4 (YXD-YEG temperature difference was 3C°).

Broad-scale surface and upper air conditions (Figure 37) showed general ridging as a new disturbance approached from the southwest. The shift to easterly surface winds near noon was a manifestation of the approach of the latter system.

The trajectory that terminated at EDMU near the time of the PAN maximum (Figure 38) was clearly influenced by the wind shift. The trajectory that ended at EDMU at the time of the secondary evening maximum originated northwest of YED 24 hours earlier (Figure 39), although it arrived in the city after a long fetch from the east. Pollutants that resulted in PAN at Ellerslie may have originated in Edmonton.

4.6.1.5.4 Case 5, Episode 4, 1983 August 05. PAN concentrations as shown in Figure 34 exceeded 0.50 ppb continuously from about 05/0930 MST to 05/2330 MST, with a primary peak at 1000 MST (1.82 ppb). As on the previous evening, there was a tendency toward a secondary maximum

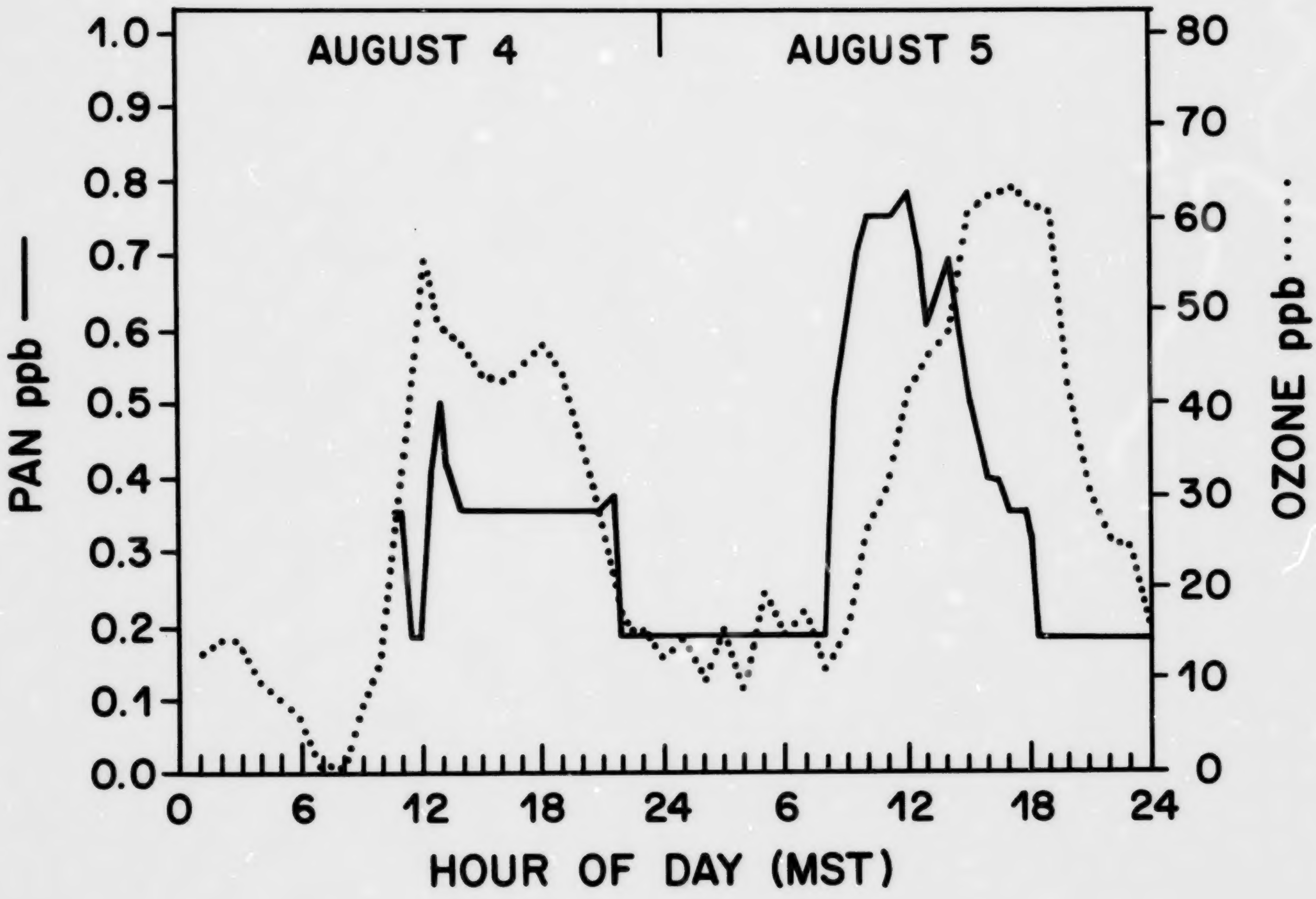


Figure 35. PAN and ozone concentrations in Ellerslie, 1983 August 04 and 05. Case 5. episodes 3 and 4.

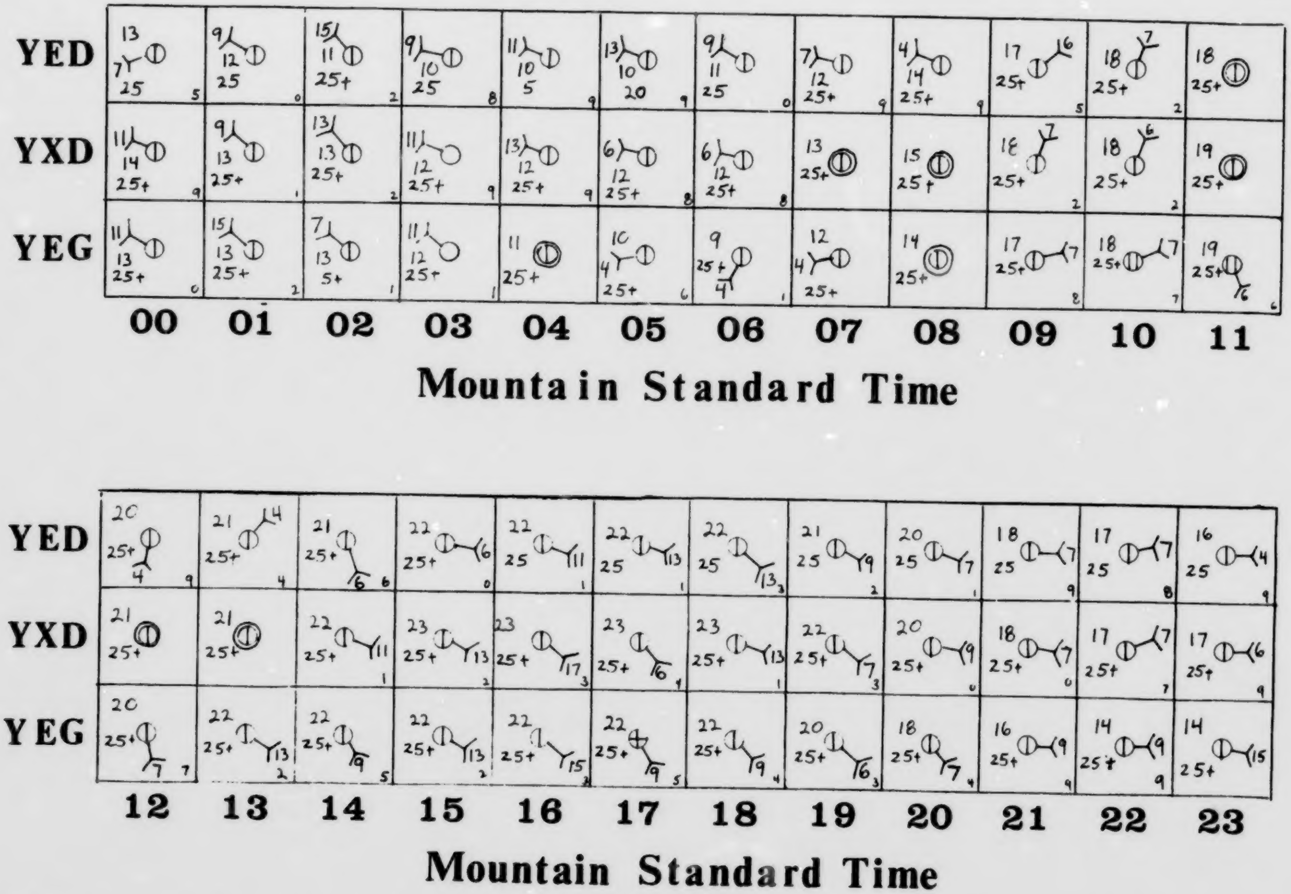


Figure 36. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 04. Case 5, Episode 3. Explanation of symbols appears in Table 2.

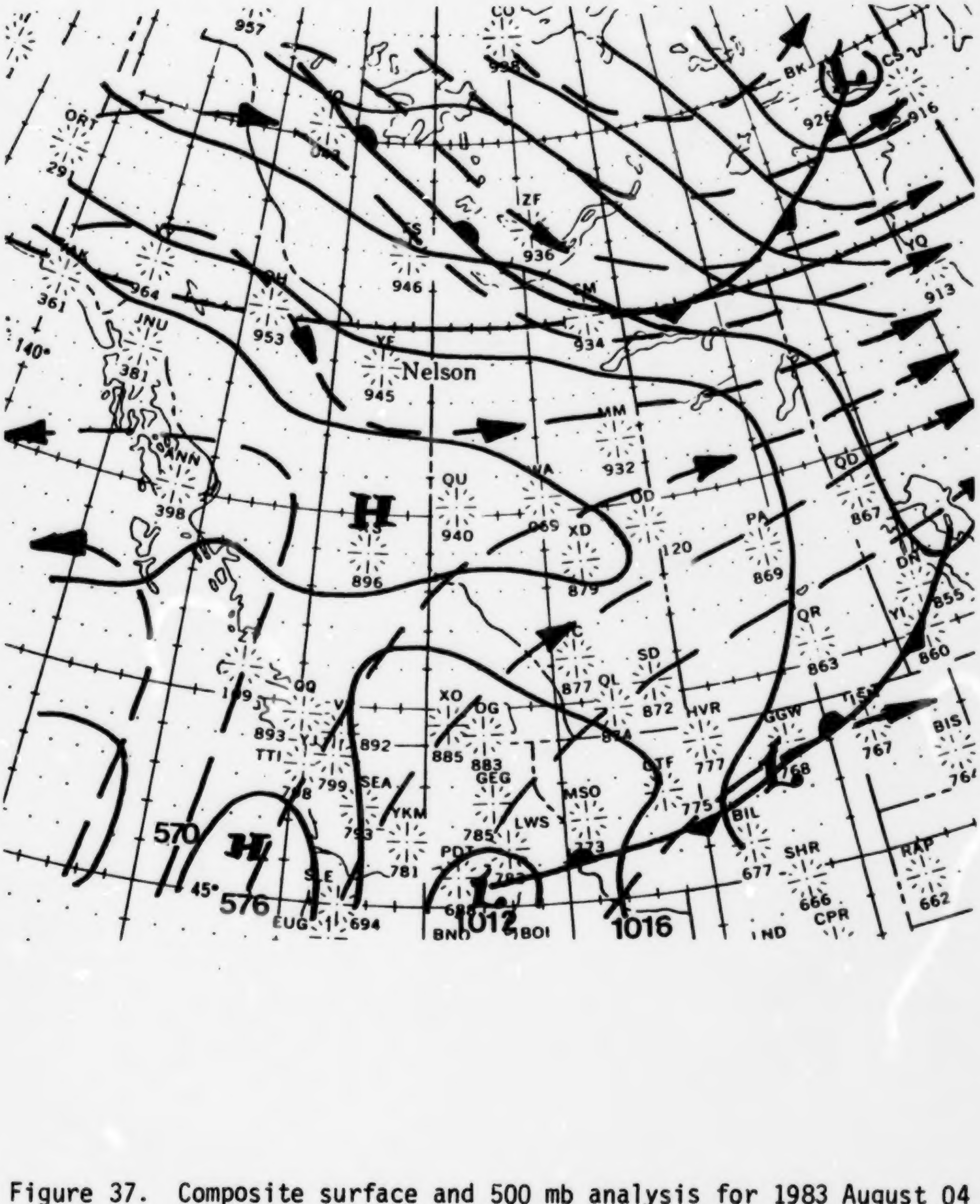

CU
957
938
BK
CS
L
926
916
ORT
291
ZF
936
946
YQ
913
361
JNU
964
953
CM
934
140°
381
YE
Nelson
945
MM
932
ANN
398
QU
940
H
896
WA
OD
06S
XD
879
120
PA
869
QD
867
DN
855
QR
863
YI
860
SD
QL
877
872
HVR
777
GGW
768
767
BIS
764
109
QQ
893
YJ
TTI
798
799
SEA
892
XO
OG
885
883
GEG
LWS
MSO
773
GTF
775
BIL
677
SHR
666
CPR
RAP
662
YKM
793
781
785
PDT
570
H
576
45°
SLE
EUG
694
BNO
L
1012
BOI
1016

Figure 37. Composite surface and 500 mb analysis for 1983 August 04 at 1700 MST. Case 5, Episode 3. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

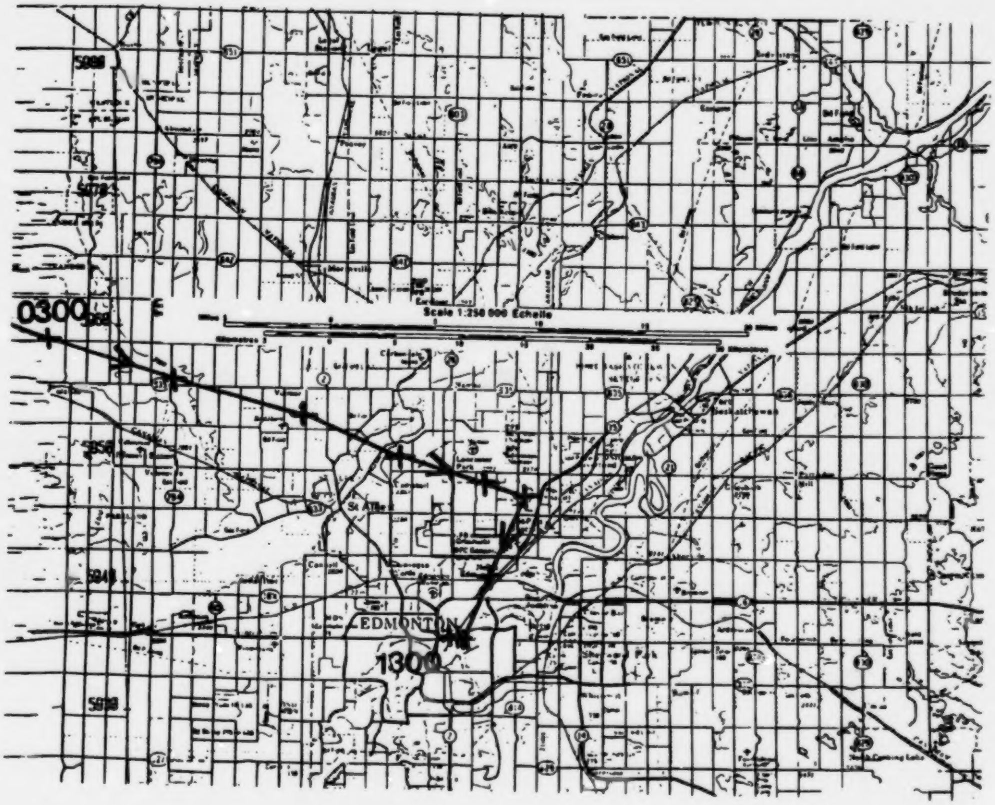

0300
1300
EDMONTON
St Albert
Scale 1:250 000 Echelle

Figure 38. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1300 MST, 1983 August 04. Case 5, Episode 3. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

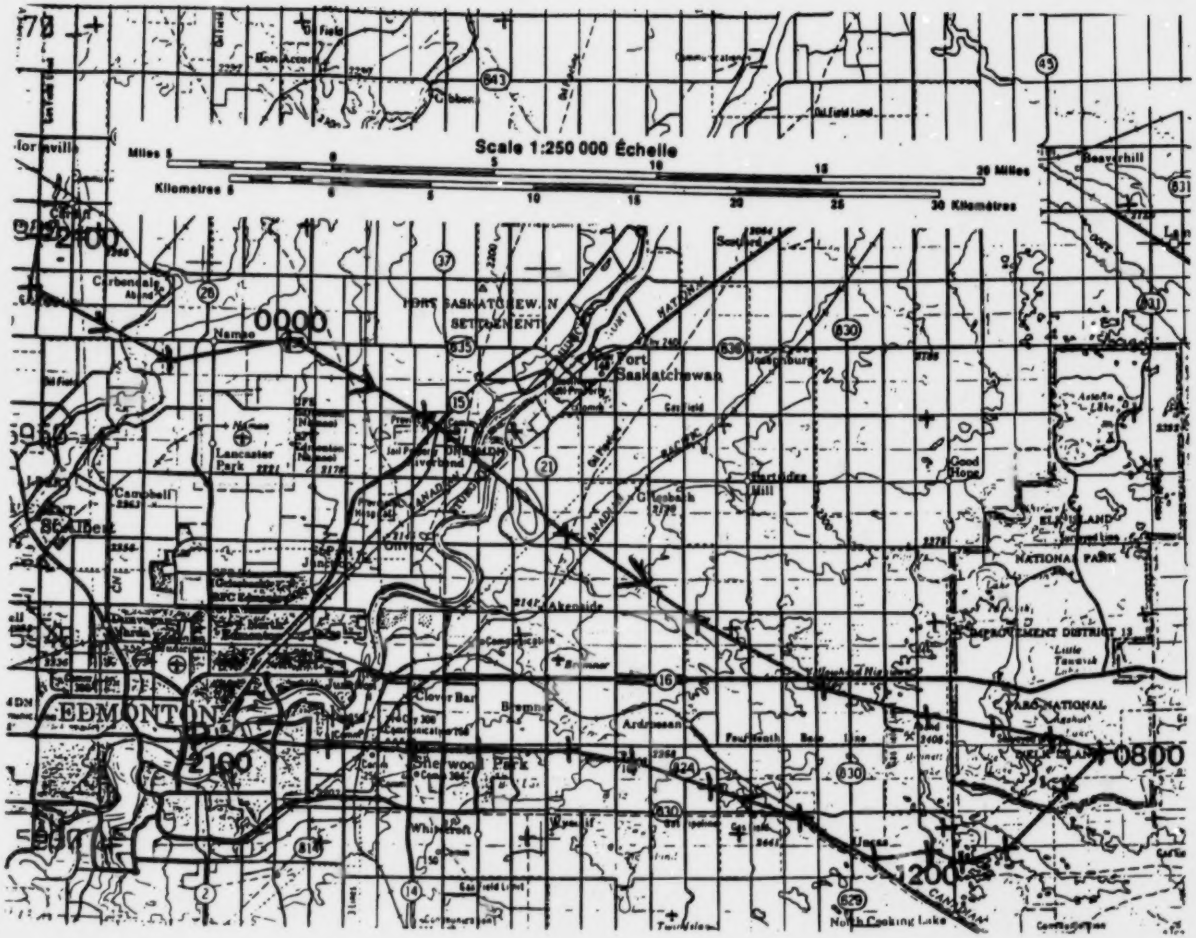

Scale 1:250 000 Échelle
Miles 5
0
5
10
15
20 Miles
Kilometres 5
0
5
10
15
20
25
30 Kilomètres
2100
0000
0800
1200
2100
EDMONTON
Fort Saskatchewan
FORT SASKATCHEWAN SETTLEMENT
Namao
Lancaster Park
Carbondale
Campbell
St. Albert
Bon Accord
Gibbons
Josephburg
Good Hope
Partridge Hill
Clover Bar
Bremner
Ardrossan
Sherwood Park
Whitecroft
North Cooking Lake
ELK ISLAND NATIONAL PARK
IMPROVEMENT DISTRICT 13
Beaverhill
Oliver
Lakeside
Little Tawayik Lake
Astotin Lake
Scotford

Figure 39. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 2100 MST, 1983 August 04. Case 5, Episode 3. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

near 2000 MST. The asymmetry noted in the PAN records of episodes 1 and 3 is also apparent in Episode 4.

Ozone concentrations increased from 10 ppb at 0800 MST to a maximum of 40 ppb at 1600 MST, which was later in the day than the maximum in the PAN. Nitrogen oxides declined from a maximum of 130 ppb at 0800 MST to a minimum of 30 ppb at 1400 MST.

PAN concentrations at Ellerslie on August 5 reached a maximum of 0.78 ppb at 1200 MST (Figure 35, Table 7), two hours later than the spike in PAN concentration recorded in Edmonton. Ozone reached a maximum of 63 ppb late in the day, at 1700 MST, thus the PAN maximum preceeded the ozone maximum by five hours.

Surface and upper air conditions illustrated for the previous afternoon in Figure 37, progressed northeastward during the evening and early morning hours. These culminated in shower and thunderstorm activity, with overcast or nearly overcast skies and easterly winds from about 05/0500 MST to 05/0900 MST (Figure 40). At the time of the PAN maximum, the mixing depth was at least 2400 m AGL. Sky cover decreased to less than 50% thereafter, and winds veered to southerly and southwesterly after 1200 MST.

The trajectory that arrived at EDMU at the time of the PAN maximum is shown in Figure 41. The influence of the moderate easterly flow is clearly indicated. The trajectory for the second peak was not computed because of missing data.

4.6.1.6 Case 6, 1983 August 21 to 26. Case 6 is actually a series of five PAN episodes that occurred between 1983 August 21 and 26 (Table 10). During the first two episodes there was a general increase in the background level of PAN beginning about 21/1200 MST, with an extreme of 7.51 ppb at 23/0930 MST. Thereafter, PAN values generally decreased through August 24 (Episode 4) to August 25, a day which was relatively "clean" (PAN concentrations of 0.50 ppb). The fifth episode occurred when PAN values showed an abrupt peak at 26/1030 MST, followed by a gradual decrease to less than 0.50 ppb after 26/2400 MST.

Elevated PAN concentrations, above the detection limit of 0.27 ppb, were also recorded at Fort Saskatchewan on August 21, 22, 24, 25, and 26.

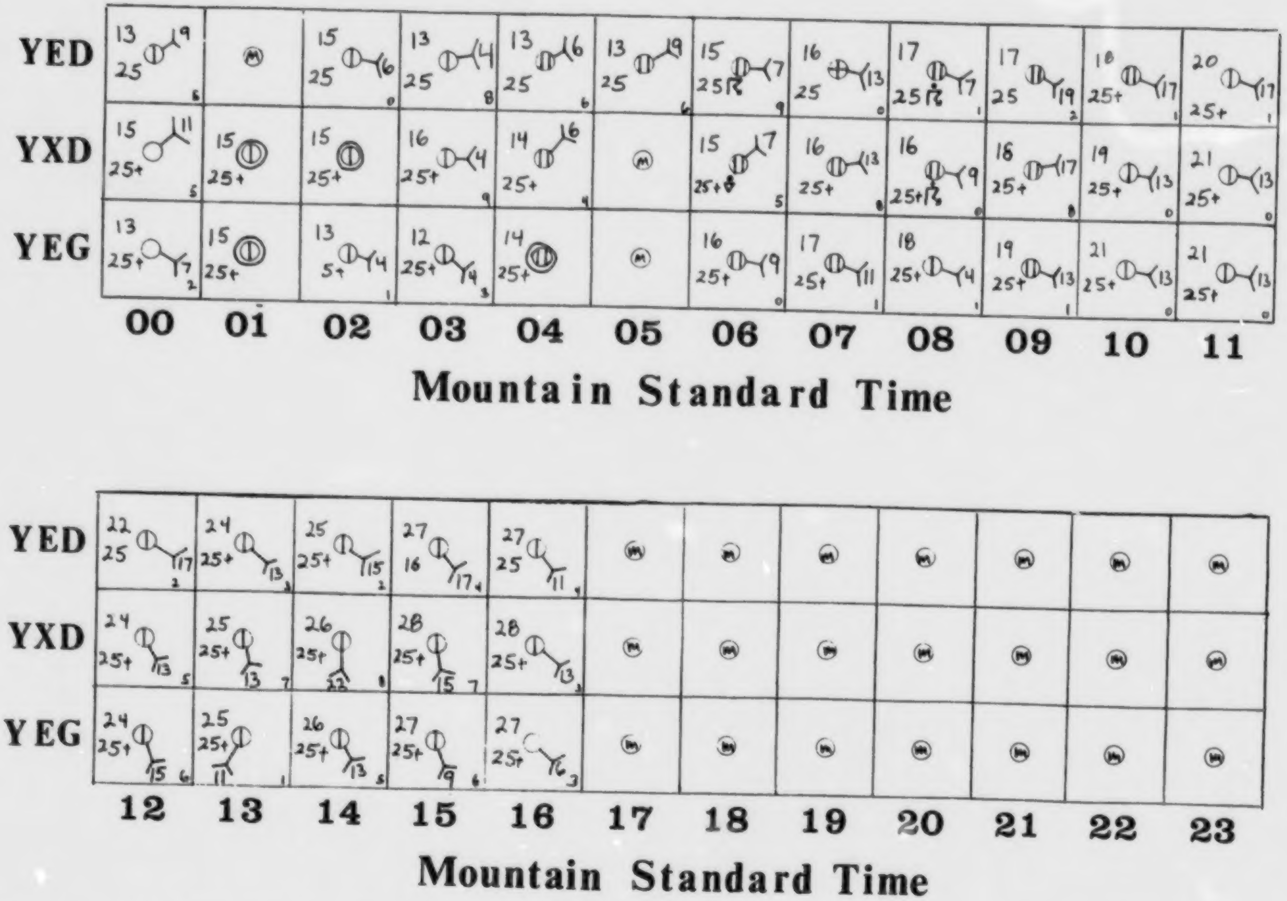


Figure 40. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 05. Case 5, Episode 4. Explanation of symbols appears in Table 2.

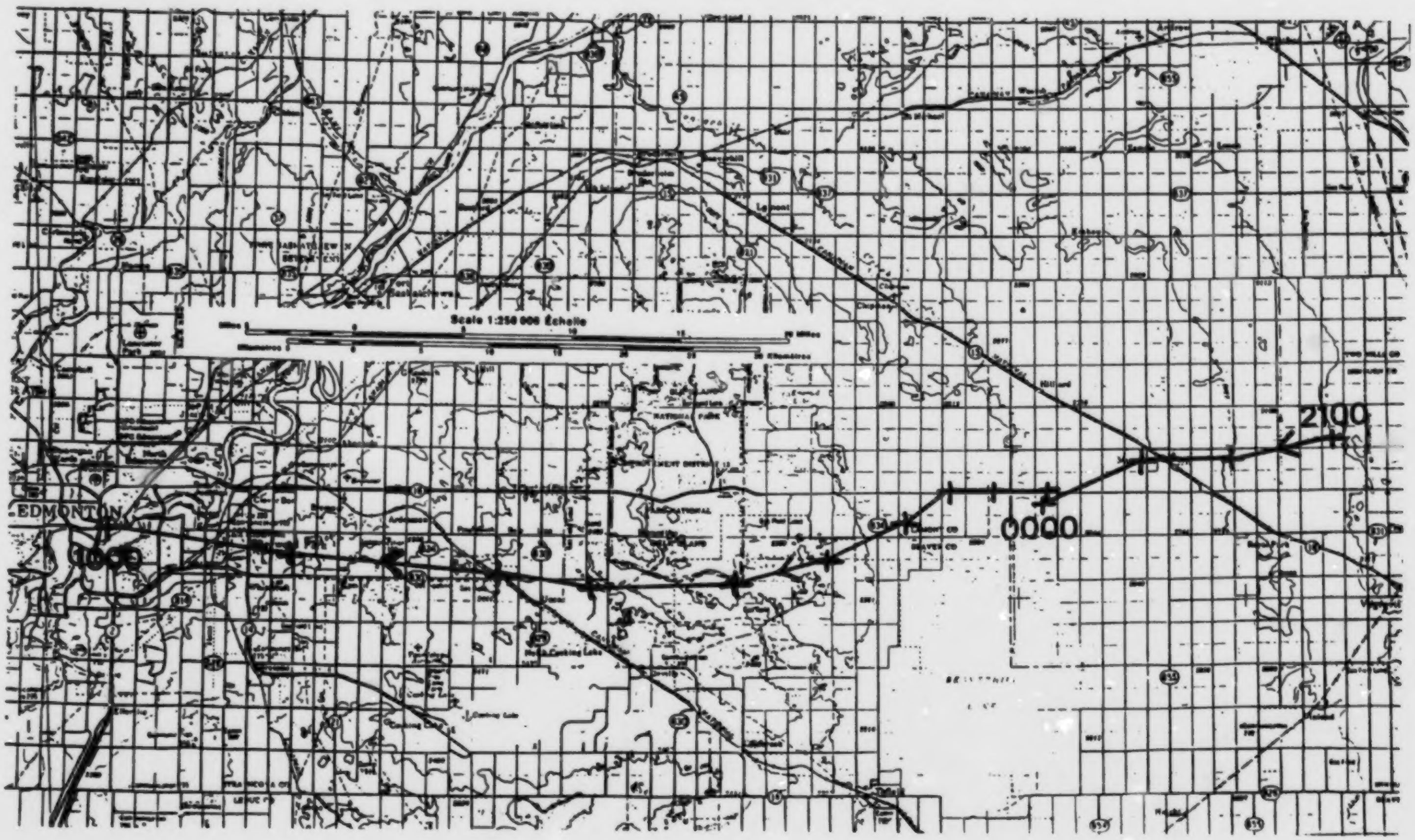

2100
0000
1000
EDMONTON
Scale 1:250 000 Échelle

Figure 41. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1000 MST, 1983 August 05. Case 5, Episode 4. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

The large-scale meterological conditions during Case 6 (figures 45, 53, 58, 63) were characterized by a broad-scale split in the upper air flow regime. A cut-off trough along the west coast of North America gave rise to southwesterly flow aloft and two well-defined storm tracks. One lay across the northwestern United States into Saskatchewan, while the other track was found across the Yukon and Northwest Territories. Thus, air quality conditions in central Alberta were influenced by very weak synoptic disturbances moving along both storm tracks. These disturbances gave rise to subtle but important changes in wind, stability, and cloud cover. Details are given on the following pages.

4.6.1.6.1 Case 6, Episode 1, 1983 August 21. For the purposes of discussion and analysis, Case 6, Episode 1 was defined as 21/1100 MST to 22/0600 MST. Episode 1 is most notable for the general increase of background PAN concentrations in Edmonton after about 21/1200 MST (Figure 42). Two rather flat peaks occurred at 21/1500 MST (0.71 ppb) and 21/2100 MST (0.86 ppb).

The case was interesting because of the double PAN peaks, one of which coincided with the ozone maximum, the other with the maximum in nitrogen oxides (Figure 42). The maximum ozone concentration of 33 ppb was reached at 1600 MST, shortly after the first PAN peak. At this time, the nitrogen oxides concentration was 20 ppb. The maximum nitrogen oxides concentration of 80 ppb was reached at 2100 MST, at the same time as the second PAN peak. At this time, the ozone concentration was 3 ppb. The occurrence of a PAN peak later in the day and in the absence of ozone is unusual. PAN generated earlier in the day was apparently recirculated over the monitoring station. During this period of recirculation, ozone would be depleted more rapidly than PAN, leaving a very low ozone to PAN ratio of 3.5.

PAN concentrations at Fort Saskatchewan reached 0.32 ppb at 1700 MST and remained at this level until 1900 MST, when the instrument malfunctioned (Figure 43). Ozone concentrations rose from less than 0.5 ppb at 0300 MST to a maximum of 71 ppb at 1700 MST, coincidental with the occurrence of PAN. Ozone concentrations declined to 1 ppb by 2300 MST. No NO_x data was available.

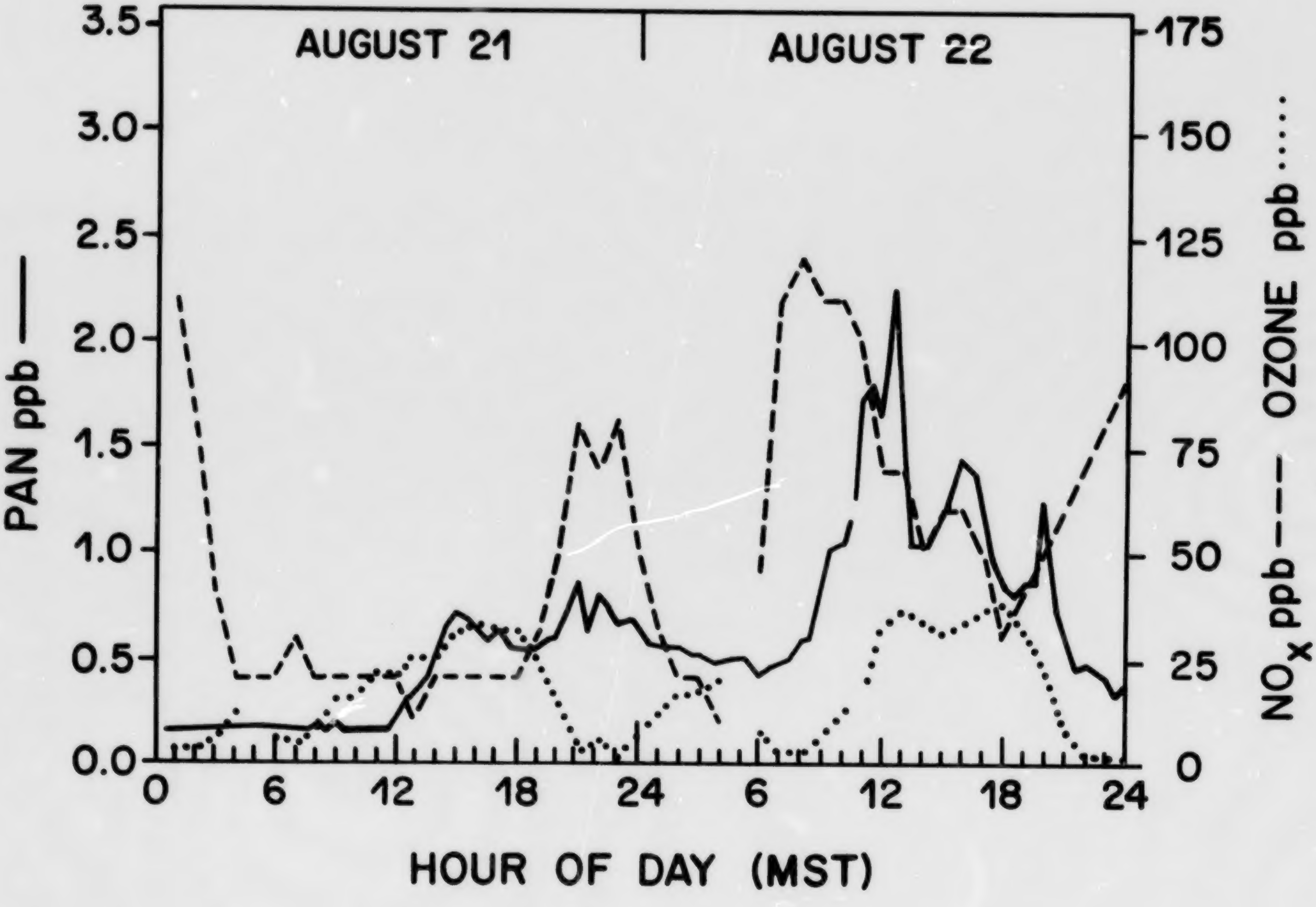


Figure 42. PAN, ozone, and NO$_x$ concentrations in Edmonton, 1983 August 21 and 22. Case 6, episodes 1 and 2.

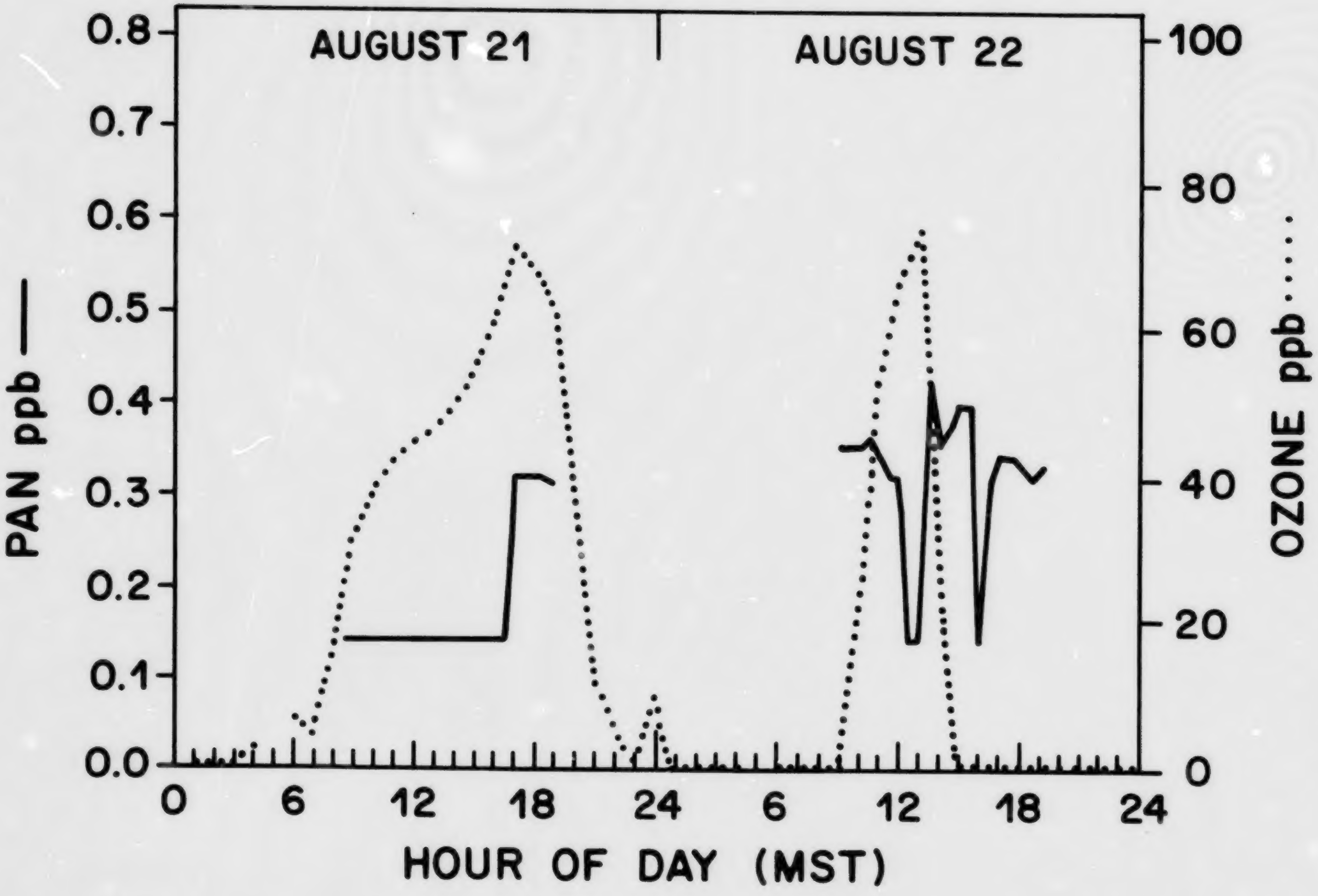


Figure 43. PAN, ozone, and NO_x concentrations in Fort Saskatchewan, 1983 August 21 and 22. Case 6, episodes 1 and 2.

Surface winds were weak westerly in the late morning of August 21 (14 km·h^{-1}). After that time they shifted to light southerly at the three Edmonton airport stations (Figure 44). Skies were generally clear to scattered, with coverage less than or equal to 50% except for a few brief periods at YEG. Visibility remained good (25 km) for the entire period. The height of cumulus cloud bases indicated that the maximum mixing depth exceeded 1800 m. The maximum temperature was 21^{o}C and the minimum was 7^{o}C at YEG on the morning of August 22. The heat island was well defined at 21/2200 MST (YXD-YEG temperature difference was 6C^{o}).

Large-scale meteorological conditions during Episode 1 (Figure 45) were dominated by split flow aloft as noted earlier. Very weak short wave disturbances moved rapidly eastward in the northern branch of the split, passing Edmonton at about 18-hour intervals. The southern branch of the current was characterized by ridging. A TROWAL, apparently related to the northern track, moved across western Alberta at the surface, with southerly flow ahead of it and northerly flow behind.

The trajectory that reached EDMU at the time of the PAN maximum for the day (21/2100 MST) is presented in Figure 46. Clearly, the air had its source southwest of Edmonton. It appears to have stagnated north of the city as the weak pressure gradient at the axis of the TROWAL reached Edmonton. The final entry of the air into the city was apparently controlled by a combination of the passage of the TROWAL and the heat island circulation (Hage 1972; Campbell 1972). Winds were very light during the three-hour period prior to the PAN maximum possibly contributing to a build-up of PAN and/or NO_x just north of the city.

4.6.1.6.2 Case 6, Episode 2, 1983 August 22. PAN concentrations for Episode 2 in Edmonton (Figure 42) show a series of three prominent peaks at 1230 MST (2.26 ppb), 1600 MST (1.42 ppb), and 2000 MST (1.25 ppb). This episode is defined as the period during which concentrations exceeded 0.50 ppb (22/0600 MST TO 23/0000 MST).

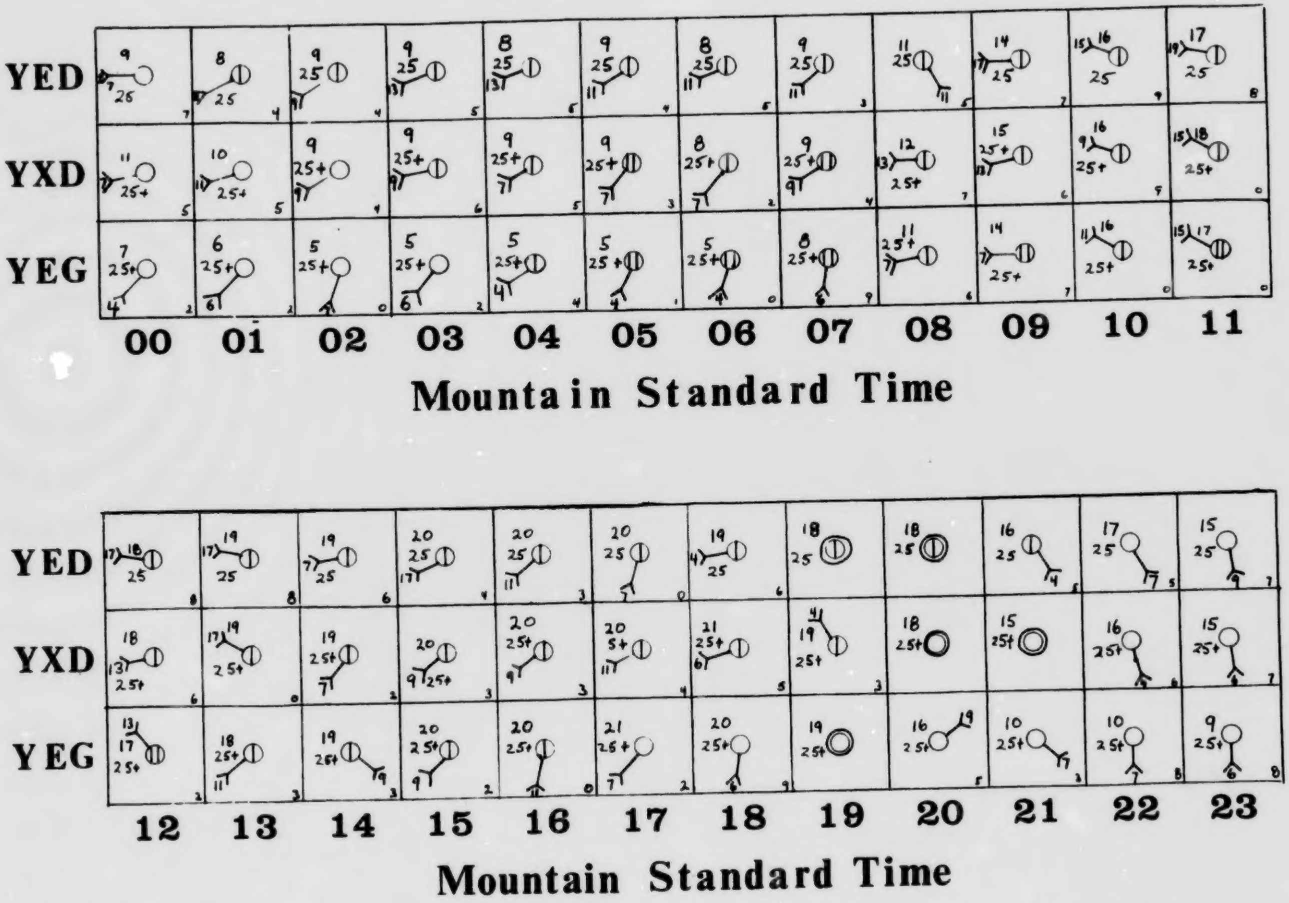


Figure 44. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 21. Case 6, Episode 1. Explanation of symbols appears in Table 2.

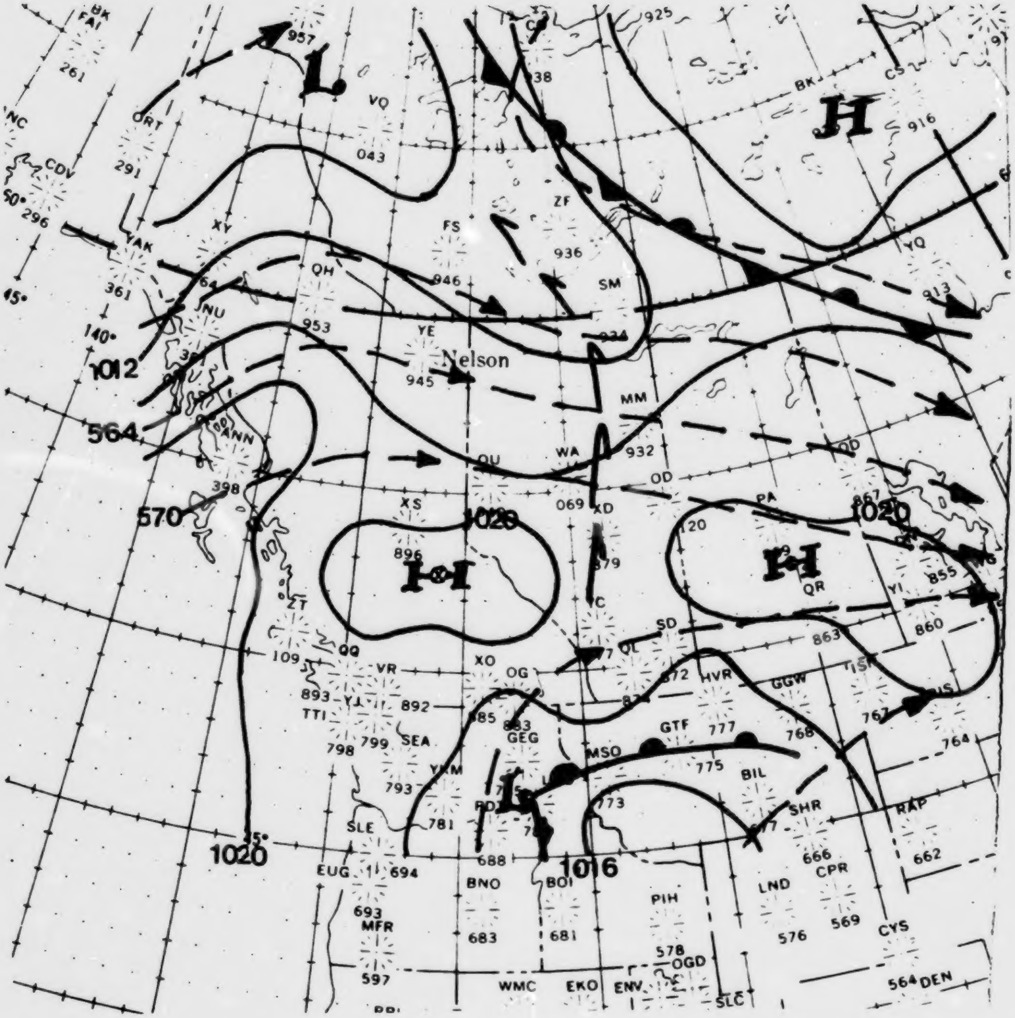

L
H
1012
564
570
1020
1020
1020
1016
Nelson
925
957
261
291
296
361
398
043
936
946
953
945
934
932
069
896
109
893
892
798
799
793
781
688
694
693
683
681
597
773
775
777
768
767
764
666
569
576
578
564
662
855
860
863
916
913
YAK
CDV
ORT
FAI
VQ
XY
QH
FS
ZF
SM
YE
MM
WA
QU
XS
XD
OD
PA
QR
YI
ZT
QQ
VR
XO
OG
SD
HVR
GGW
TTI
SEA
YKM
GEG
MSO
GTF
BIL
SHR
CPR
RAP
SLE
EUG
MFR
BNO
BOI
PIH
LND
CYS
OGD
WMC
EKO
ENV
SLC
DEN
BK
CS
YQ
140°
50°
45°
35°

Figure 45. Composite surface and 500 mb analysis for 1983 August 21 at 0500 MST. Case 6, Episode 1. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

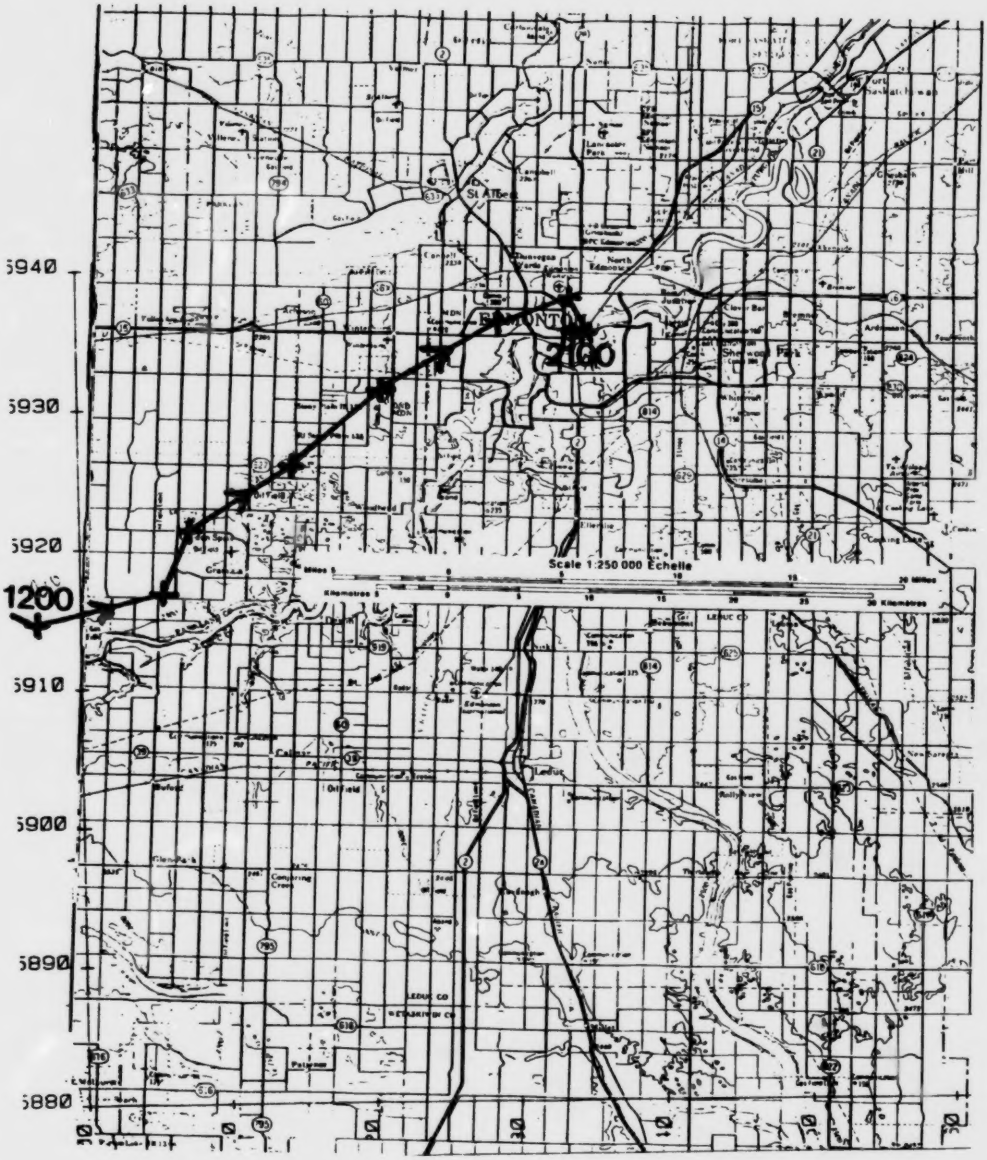

5940
5930
5920
5910
5900
5890
5880
1200
2100
EDMONTON
St Albert
Sherwood Park
Leduc
Scale 1:250 000 Échelle
Kilometres
Miles

Figure 46. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 2100 MST, 1983 August 21. Case 6, Episode 1. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

Ozone concentrations rose from 2 ppb at 0800 MST to 38 ppb at 1300 MST, corresponding to the first PAN peak. A second ozone maxima of 38 ppb was reached at 1800 MST. The major PAN peak at 1230 MST occurred as ozone concentrations were rising and NO_x declining from a maximum of 120 ppb at 0800 MST to 30 ppb at 1800 MST.

Elevated PAN concentrations were also recorded at Fort Saskatchewan during this period (Figure 43). The concentrations were not high compared with those recorded in Edmonton, which reached a maximum of 0.40 ppb at 1500 MST. Ozone concentrations at Fort Saskatchewan rose rapidly from below the 1 ppb detection limit at 0900 MST to 73 ppb at 1300 MST and declined rapidly to below the detection limit at 1500 MST. NO_x data were not available for this period.

Good visibility (>25 km) and mostly scattered (<50%) cloud cover prevailed during Episode 2 (Figure 47). Also, maximum mixing depths increased from the previous day to 1800 to 2500 m. The maximum temperature, 24°C, was observed at all airport stations, while the minimum, 6°C, was observed at YEG.

The mid-tropospheric flow patterns (Figure 45) showed increased ridging over northern Alberta. Although 500 mb heights showed little change at Edmonton, streamline curvature and weakening winds aloft also indicated an increased anticyclonic influence throughout the period.

At the surface (Figure 45), the surface trough noted in Episode 1 had passed, leaving weak pressure gradients and generally weak winds in its wake. Southerly flow developed during the day ahead of the TROWAL in western Alberta. After 22/1900 MST, winds shifted to weak northerly behind the TROWAL. Although the weak pressure gradient and relatively clear skies were conducive (again) to the development of a heat island over Edmonton during the night, the northerly flow appeared to reduce the magnitude markedly when compared with the previous night (XYD-YEG temperature difference was 5C°).

The trajectory ending at EDMU at 22/1300 MST (Figure 48) reflects the weak southerly flow conditions. With respect to secondary PAN peaks at EDMU, trajectories terminating at 1600 MST (Figure 49) and 2000 MST (Figure 50) suggest that, although the air arrived from quite

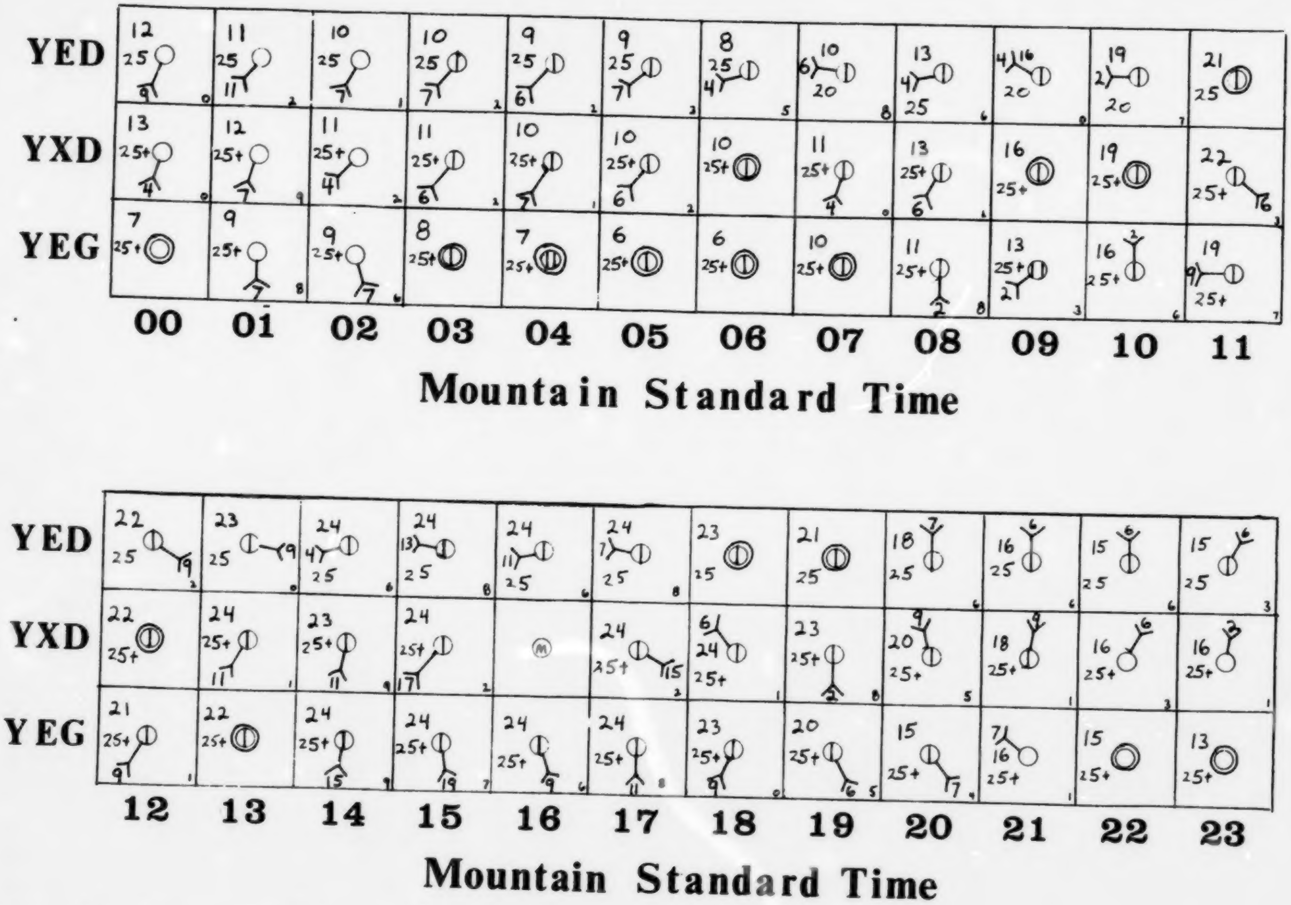


Figure 47. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 22. Case 6, Episode 2. Explanation of symbols appears in Table 2.

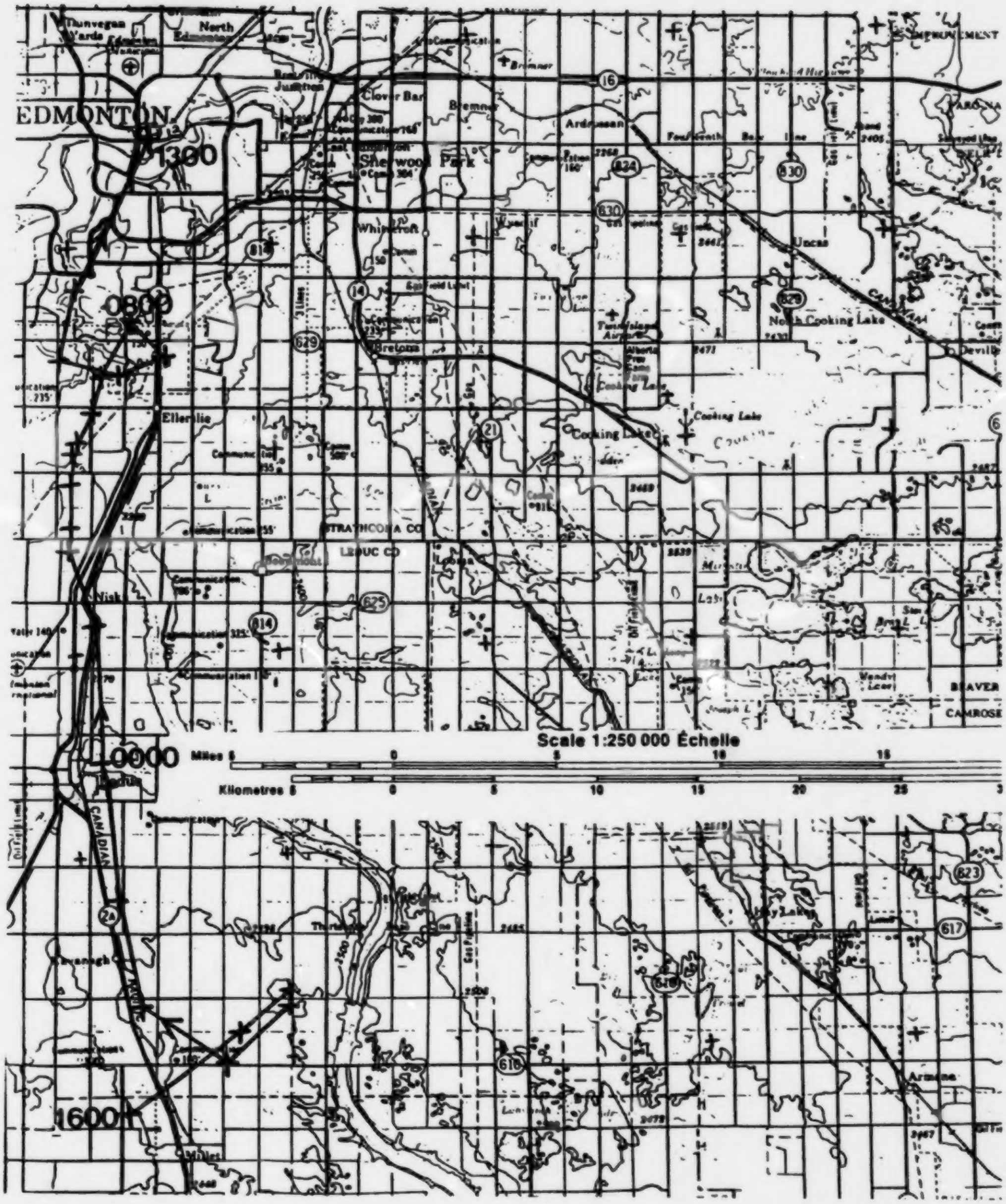

EDMONTON
1300
0800
0000
1600
Sherwood Park
Ellerslie
Nisku
Leduc
Cooking Lake
North Cooking Lake
Clover Bar
Bremner
Ardrossan
Uncas
Whitecroft
Scale 1:250 000 Échelle
Miles
Kilometres
STRATHCONA CO
LEDUC CO
BEAVER
CAMROSE
Kavanagh
Millet
Hay Lakes
Armena
CANADIAN

Figure 48. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1300 MST, 1983 August 22. Case 6, Episode 2. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

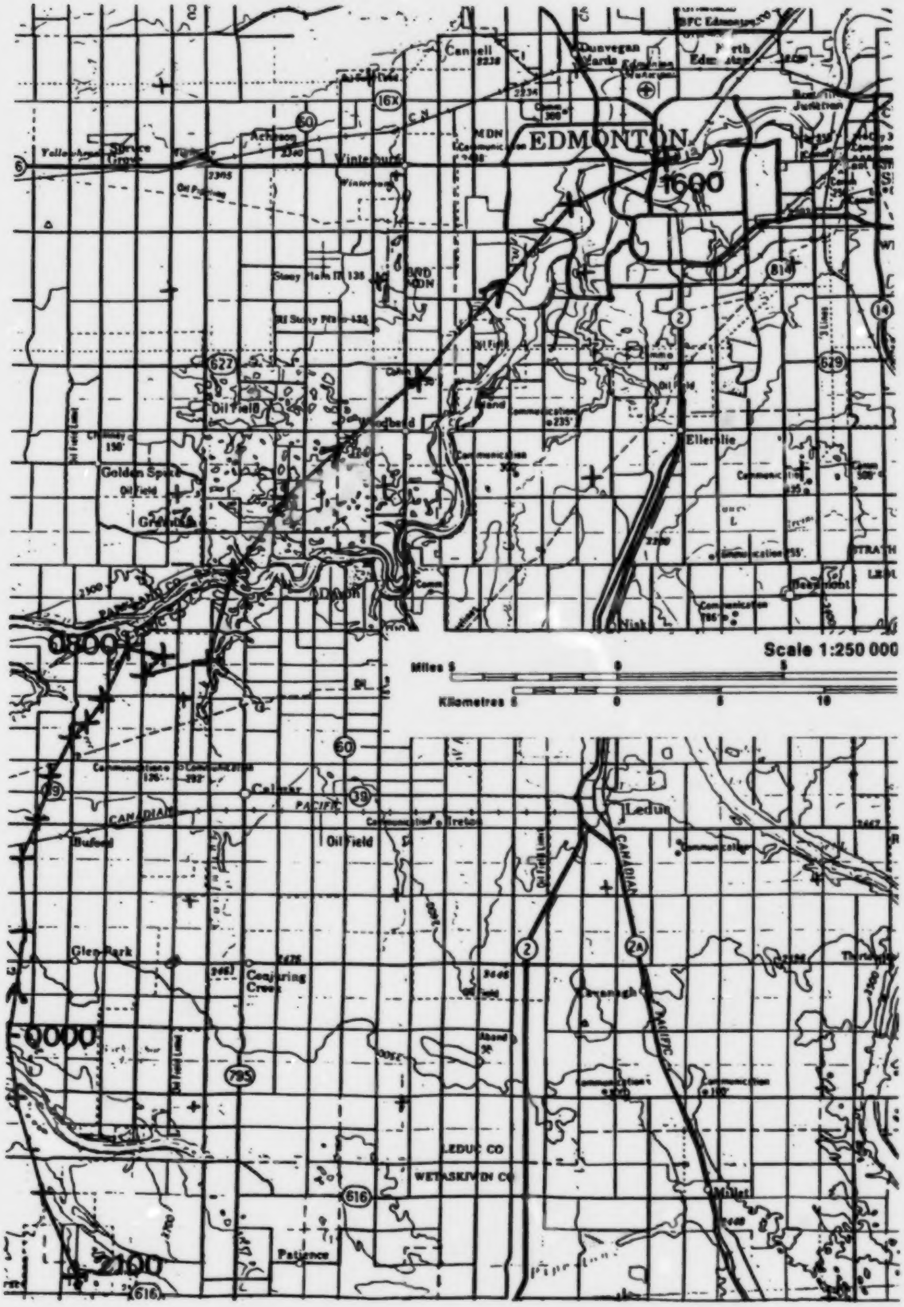

EDMONTON
1600
0800
0000
2100
Scale 1:250 000
Miles
Kilometres
Leduc
Ellerslie
Devon
Calmar
Golden Spike
Glen Park
Conjuring Creek
Patience
Nisku
Millet
LEDUC CO
WETASKIWIN CO
CANADIAN PACIFIC
2
2A
39
60
616
622
629
795
814
14
16X

Figure 49. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1600 MST, 1983 August 22. Case 6, Episode 2. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

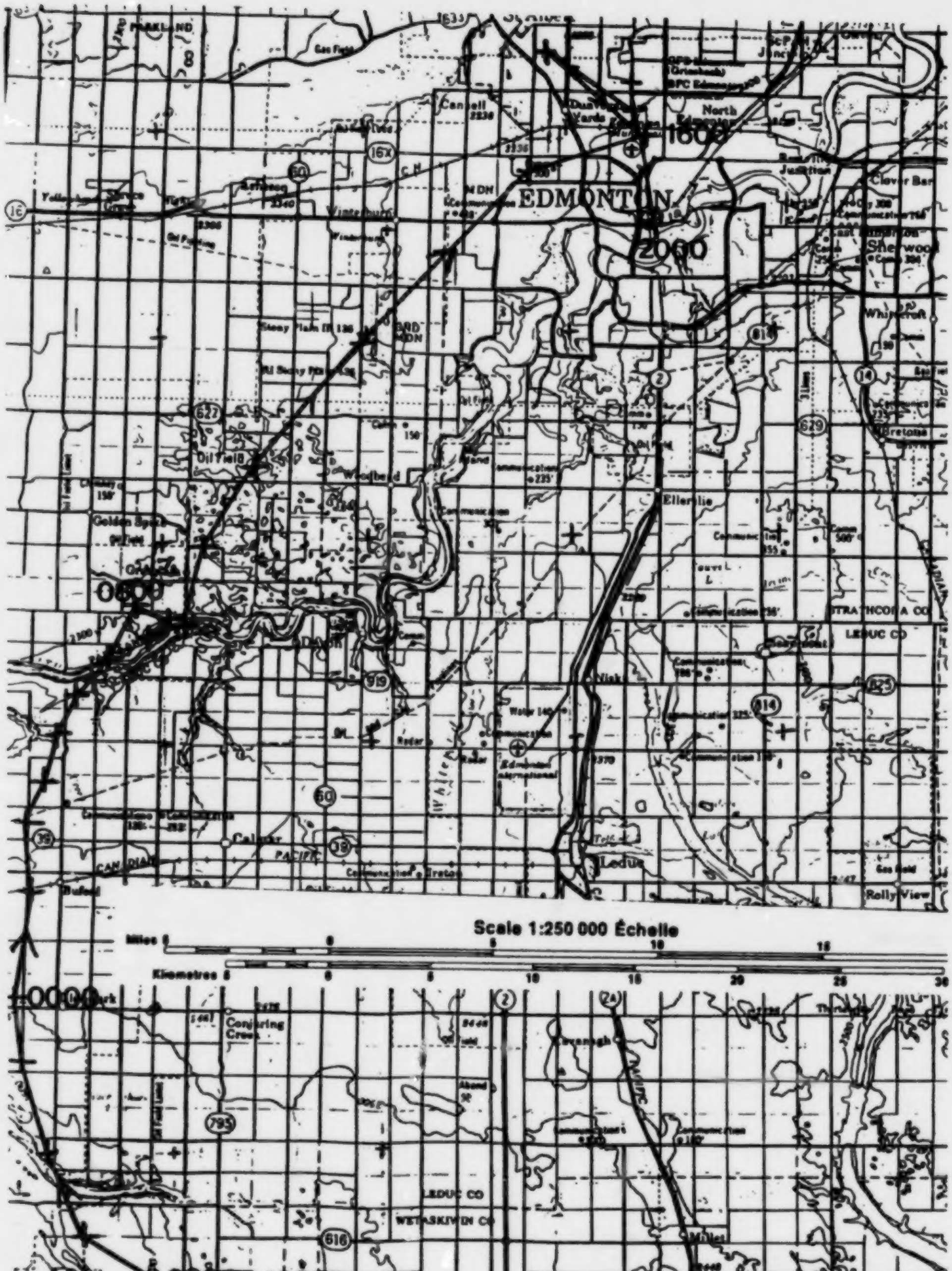

EDMONTON
1600
2000
0800
0000
2000
Scale 1:250 000 Échelle
Miles
Kilometres

Figure 50. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 2000 MST, 1983 August 22. Case 6, Episode 2. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

different directions (S, SW, and N), the source in all cases was south or south-southwest of Edmonton. It appears that heat island development may have influenced the trajectory arriving from the north at 2000 MST.

4.6.1.6.3. Case 6, Episode 3, 1983 August 23. The highest PAN concentration (7.51 ppb) for all cases considered in this study was observed in Edmonton during Episode 3 of Case 6. A narrow maximum occurred at 23/0930 MST (Figure 51). For discussion purposes, Episode 3 is defined as 23/0800 MST to 23/1800 MST (PAN concentrations > 0.50 ppb).

The rapid increase in PAN from 0.69 ppb at 0830 MST to 7.51 ppb one hour later corresponded to a decline in nitrogen oxides from 270 ppb at 0800 MST to 10 ppb at 1300 MST. During this period, ozone rose from below detection limit, less than 0.5 ppb, to 46 ppb by 1200 MST.

In Fort Saskatchewan, a PAN maximum of only 0.34 ppb was recorded at 1030 MST. At the time of the PAN maximum, ozone concentrations were rising rapidly from below the 1 ppb detection limit at 0900 MST to 87 ppb at 1400 MST. NO_x data were not available.

As shown in Figure 52, cloud cover gradually increased from 10% coverage at the time of the PAN maximum to at least 80% coverage later in the day. The change was due primarily to increased convective activity, especially south of Edmonton. At the time of the PAN peaks, winds were calm or very weak east-southeasterly, while at the end of the episode they had veered to southeasterly at 10 to 20 $km \cdot h^{-1}$. Visibility was generally 25 km or better except at YED, where visibility was restricted to 11 km in the early morning hours due to fog and haze. The minimum temperature on August 23 was $5^{o}C$ at YEG, while the maximum was $26^{o}C$ at all three airport stations. There was a definite heat island effect on the mornings of August 23 and 24, but it was weaker on the August 24 (XYD-YEG temperature difference was $7C^{o}$ vs. $5C^{o}$).

The large-scale meteorological conditions at the end of the episode are illustrated in Figure 53. The increased convective activity and the southeasterly flow discussed above are clearly associated

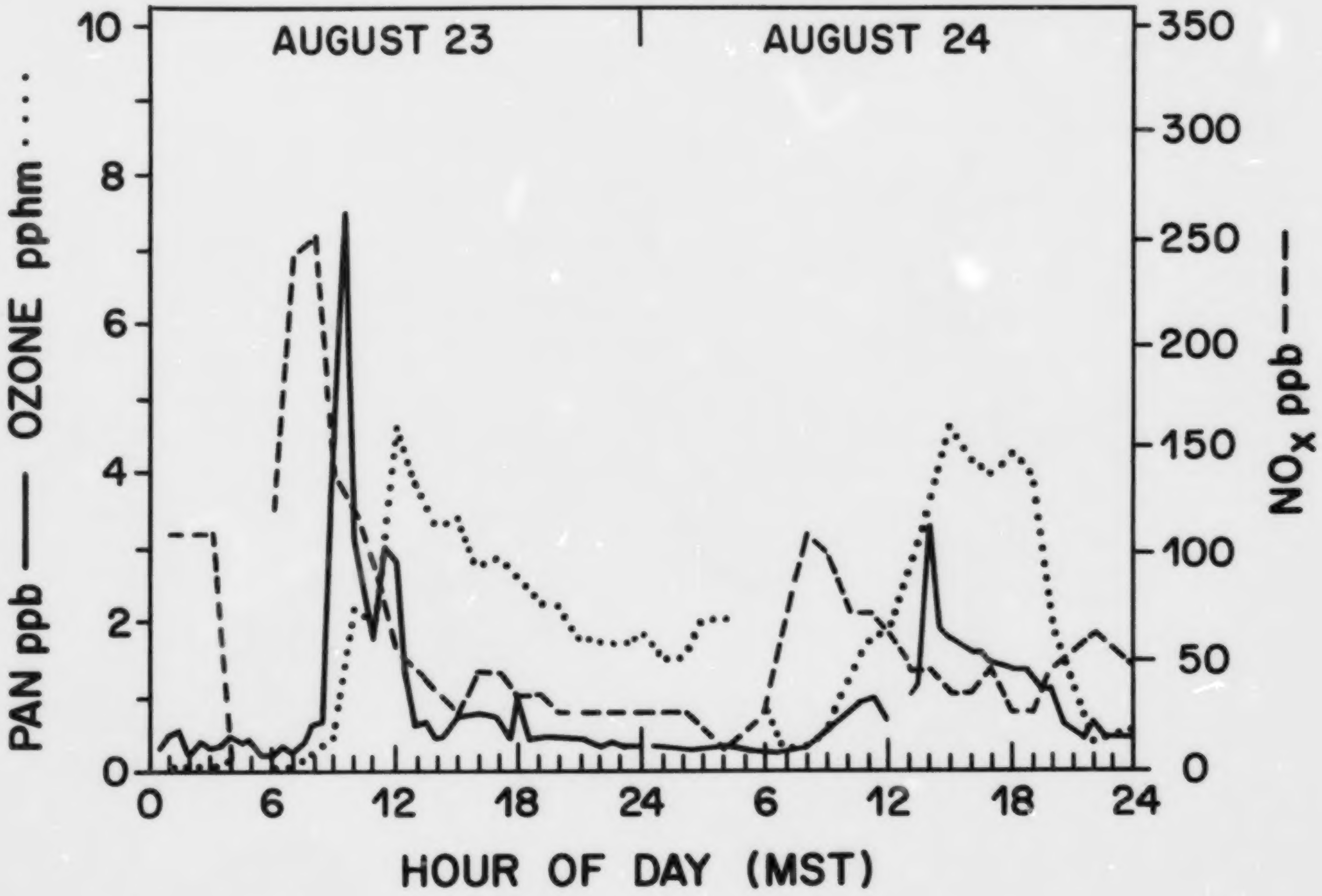


Figure 51. PAN, ozone, and NO$_x$ concentrations in Edmonton, 1983 August 23 and 24. Case 6, episodes 3 and 4.

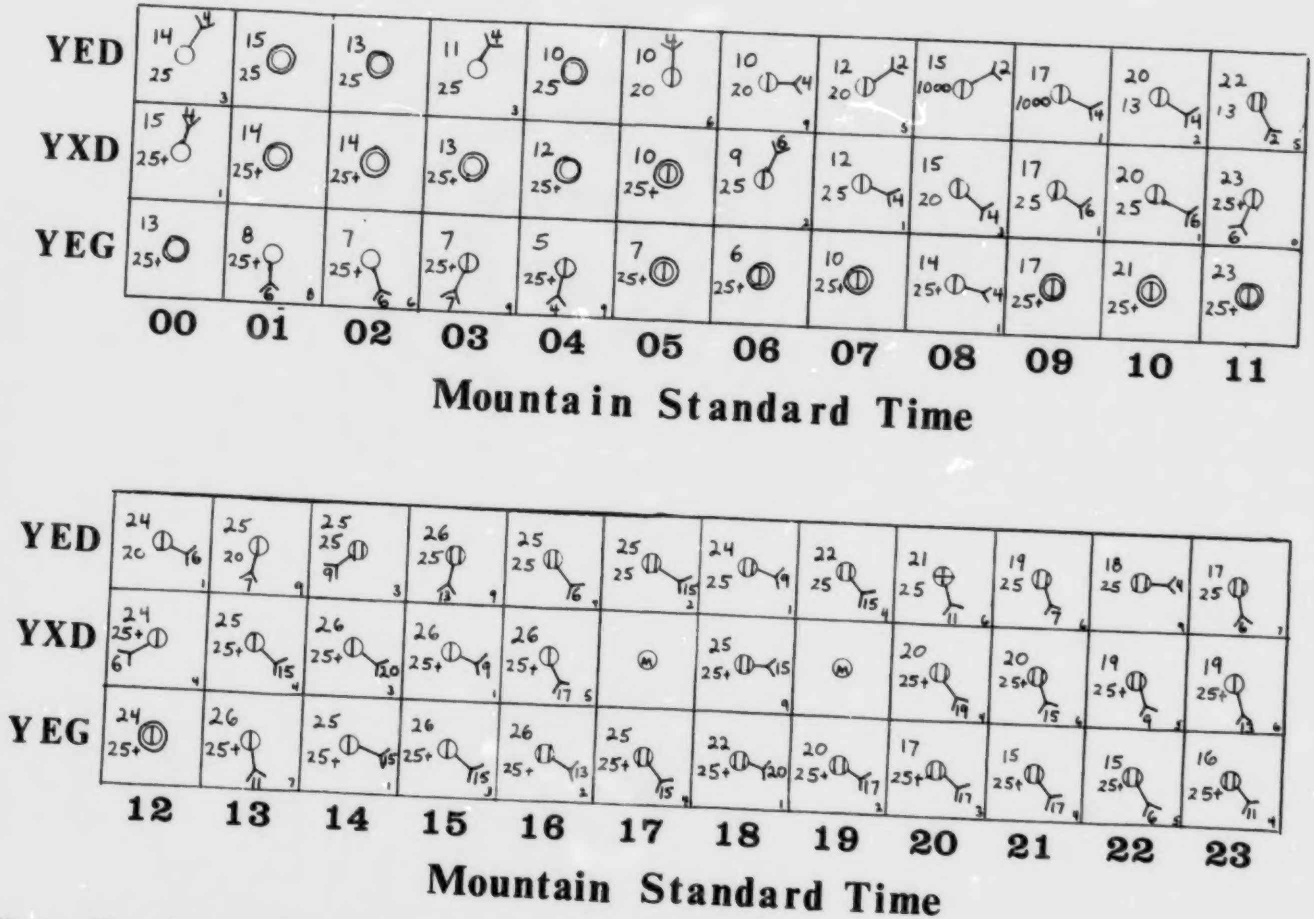


Figure 52. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 23. Case 6, Episode 3. Explanation of symbols appears in Table 2.

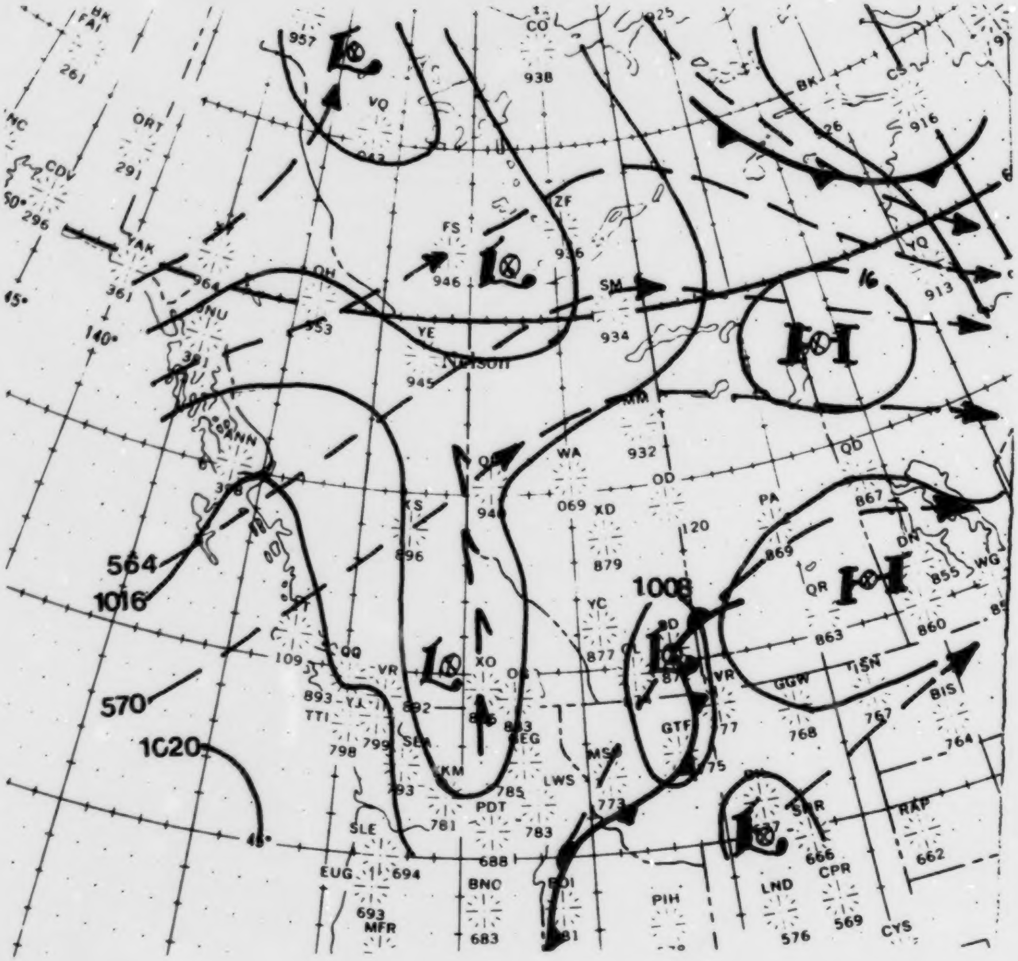

564
1016
570
1020
1008
Nelson
120
140°
45°
50°
16

Figure 53. Composite surface and 500 mb analysis for 1983 August 23 at 1700 MST. Case 6, Episode 3. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

with the surface low pressure area that had moved out of eastern Washington in the previous 36 hours (compare with Figure 45). Aloft, 500 mb heights fell over southwestern Alberta as the associated upper level disturbance approached the area. The trajectory that reached EDMU at the time of the PAN maximum is shown in Figure 54. The trajectory that ended at EDMU near 1200 MST is presented in Figure 55. The arrival of the air from the south reflects the variability of the wind near Edmonton between 1000 MST and 1500 MST.

4.6.1.6.4 Case 6, Episode 4, 1983 August 24. The PAN occurrence of August 24 in Edmonton (Figure 51) is similar to the two previous episodes of Case 6 in the asymmetric shape of PAN record, i.e., rapid increase in concentration to a sharp peak (3.30 ppb at 24/1400 MST) followed by a relatively slow decrease. Episode 4 is defined as occurring from 24/0830 MST to 24/2230 MST.

Ozone, PAN, and nitrogen oxide trends followed the now familiar pattern, with ozone and PAN increasing as nitrogen oxides declined. The PAN peak occurred much later than found on the previous day, at 1400 MST as compared with 0930 MST on August 23.

At Fort Saskatchewan, PAN concentrations exceeded the detection limit much later in the day than the occurrence of the PAN peak in Edmonton (Figure 56). PAN concentrations were not high: 0.34 ppb at 1400 MST. In contrast, ozone concentrations were high, rising from 11 ppb at 0700 MST to 85 ppb at 1600 MST; thus, the PAN maximum occurred as the ozone concentration was rising.

The finding of 85 ppb ozone, a concentration above the provincial standard of 80 ppb, was not unusual. During the month of August the one-hour standard was exceeded 30 times, and the 24-hour standard of 25 ppb was exceeded on 28 of the 31 days. The highest ozone concentration recorded during the month of August was 127 ppb on August 8. Unfortunately, no NO_x data is available for the month of August.

Surface observations from the three local airports (Figure 57) typically show that 60 to 100% cloud cover with convective activity, i.e., good vertical mixing, was common during the entire episode. Visibility exceeded 25 km for the whole PAN episode, except for a

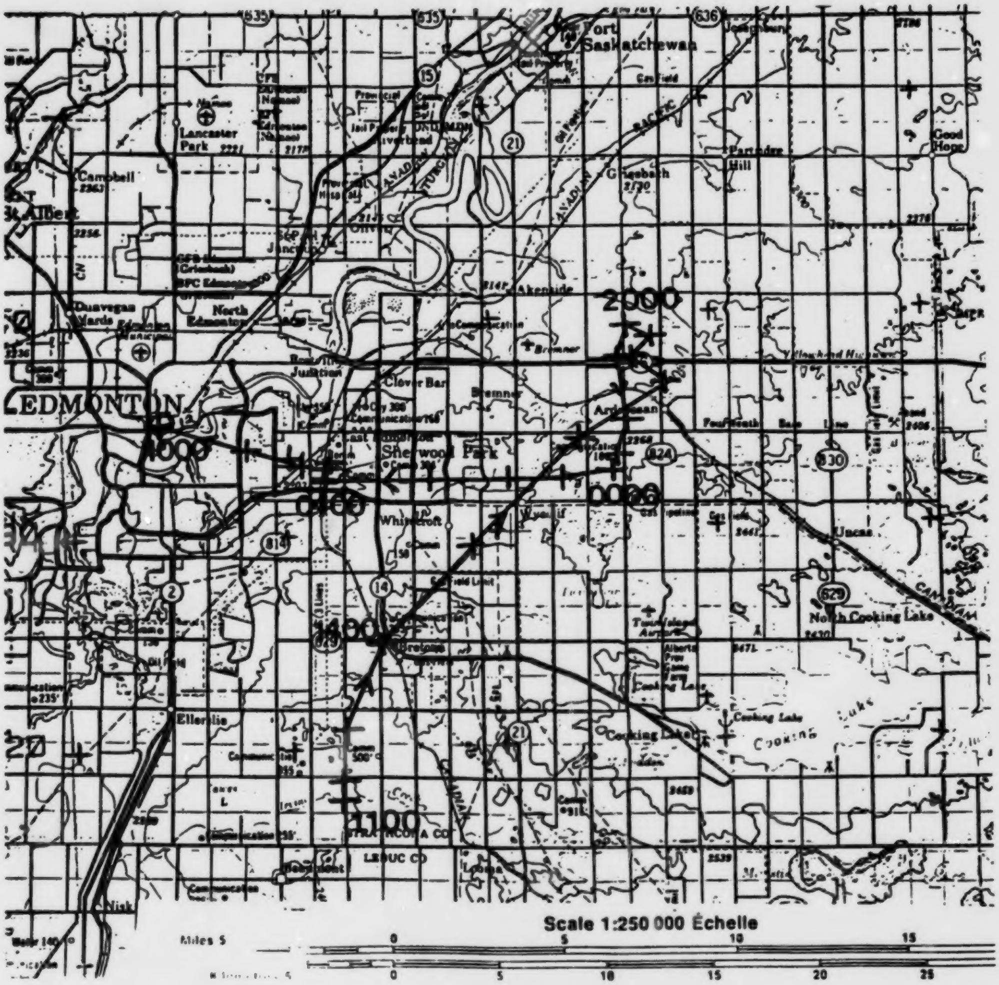

Fort Saskatchewan
Lancaster Park
Campbell
St. Albert
North Edmonton
EDMONTON
Clover Bar
Bremner
Sherwood Park
Ardrossan
Whitecroft
Akenside
Josephburg
Good Hope
Partridge Hill
Uncas
North Cooking Lake
Cooking Lake
Ellerslie
Nisku
Beaumont
2000
1000
0400
0000
1400
1100
Scale 1:250 000 Échelle
Miles 5
0
5
10
15
0
5
10
15
20
25

Figure 54. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1000 MST, 1983 August 23. Case 6, Episode 3. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

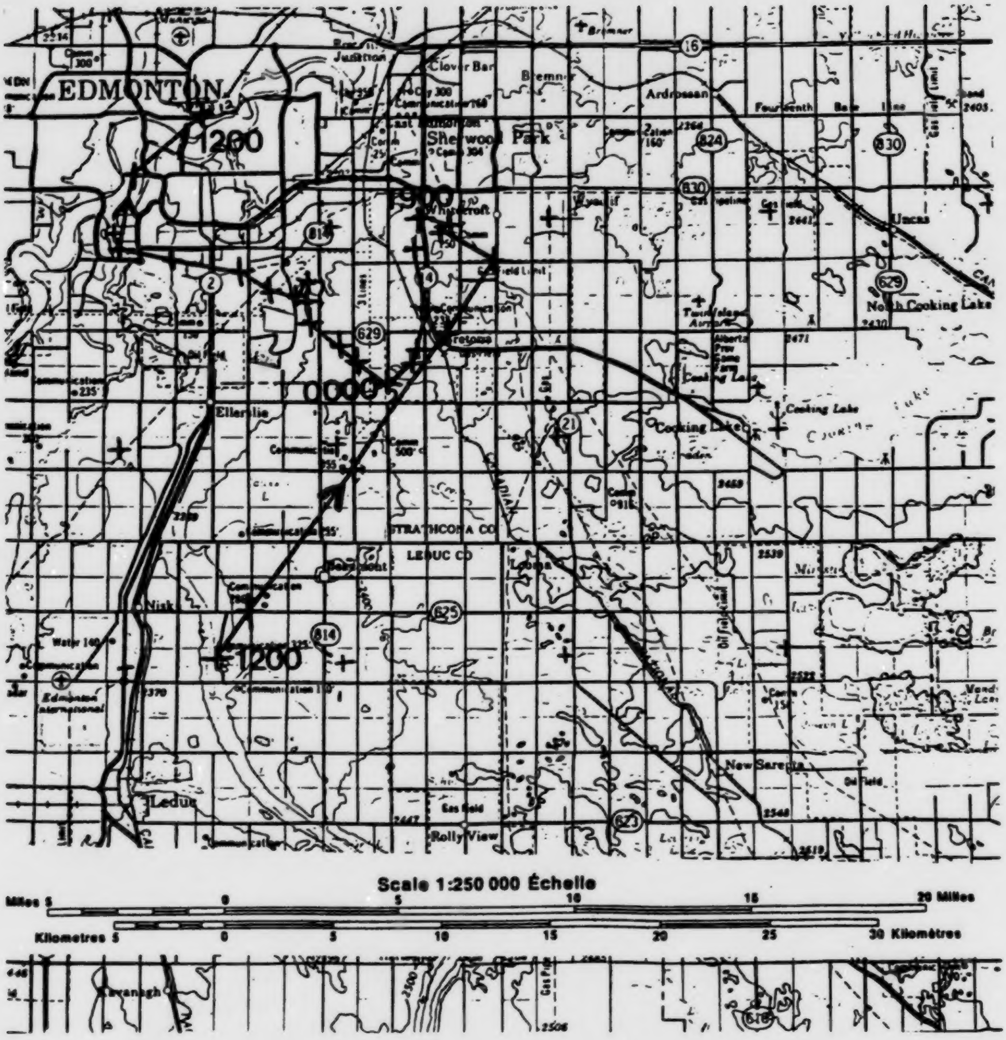

EDMONTON
1200
Sherwood Park
Whitecroft
0000
Ellerslie
STRATHCONA CO
LEDUC CO
Beaumont
Nisku
1200
Edmonton International
Leduc
New Sarepta
Rolly View
Cooking Lake
North Cooking Lake
Ardrossan
Bremner
Clover Bar
Uncas
Kavanagh
Scale 1:250 000 Échelle
Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 5 10 15 20 25 30 Kilomètres

Figure 55. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1200 MST, 1983 August 23. Case 6, Episode 3. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

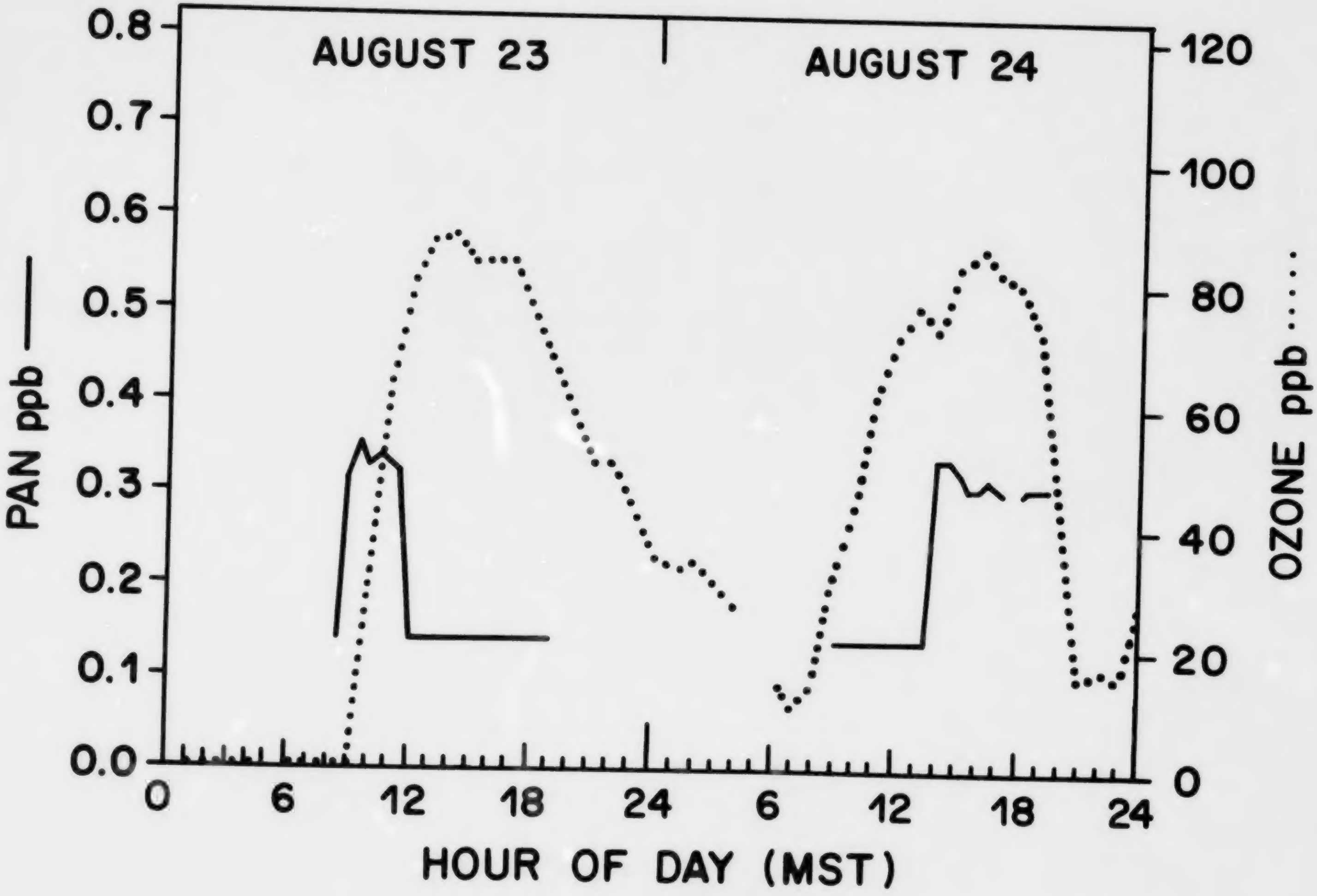


Figure 56. PAN and ozone concentrations in Fort Saskatchewan, 1983 August 23 and 24. Case 6, episodes 3 and 4.

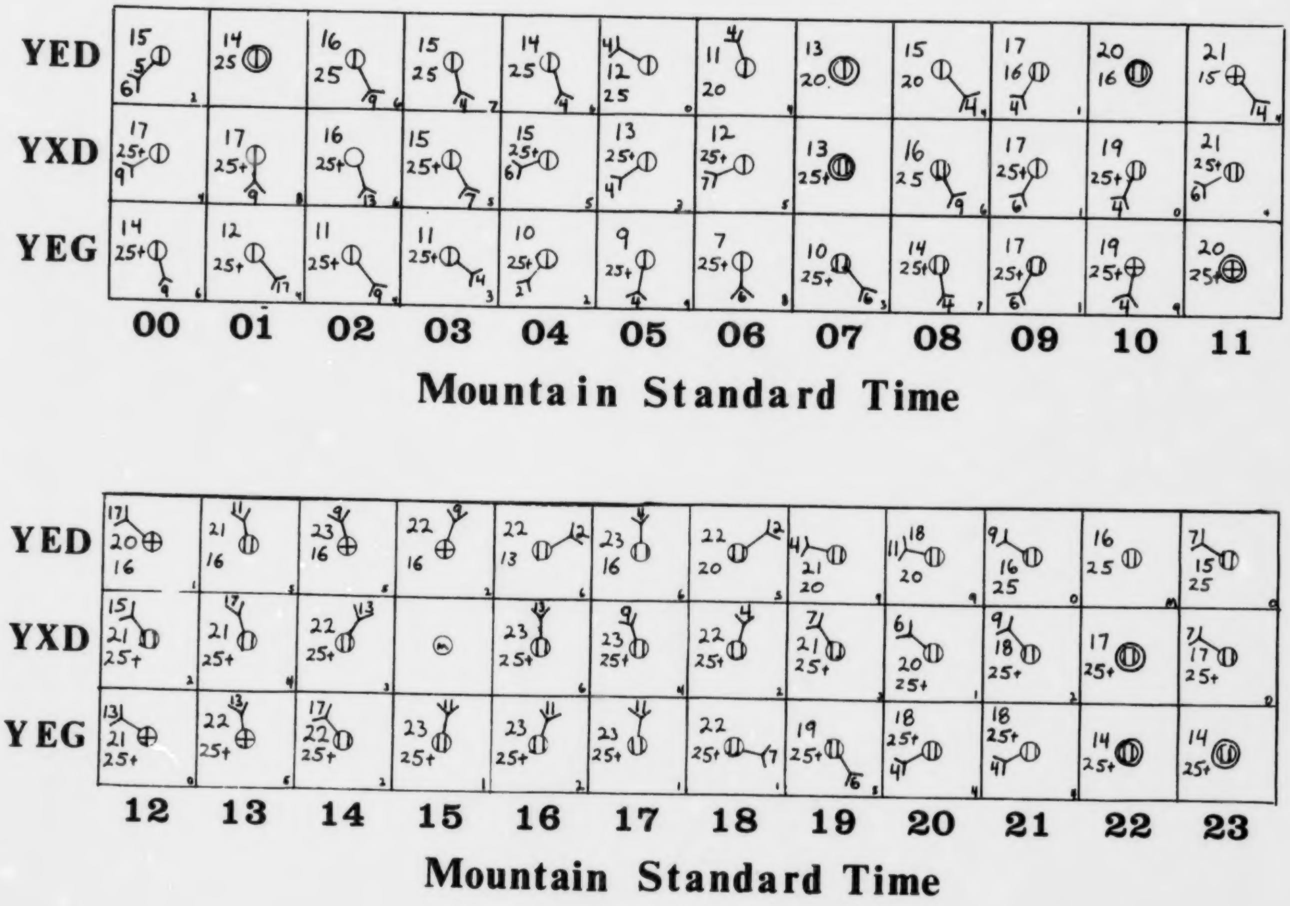

YED
YXD
YEG
00
01
02
03
04
05
06
07
08
09
10
11
Mountain Standard Time
YED
YXD
YEG
12
13
14
15
16
17
18
19
20
21
22
23
Mountain Standard Time

Figure 57. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 24. Case 6, Episode 4. Explanation of symbols appears in Table 2.

slight restriction to about 15 km with fog and haze in the morning. Surface winds showed a definite shift from a southern to a northern component at about 1200 MST, increasing in speed to about 12 km·h $^{-1}$. A greater westerly component developed near the end of the period.

Weaker, split flow continued aloft. However, by 24/1700 MST (Figure 58), two upper level disturbances came into phase on the line from just west of Fort McMurray (MM) through Glasgow, Montana (GGW). This situation is reflected in the movement of the TROWAL located over eastern B.C. (Figure 49) to the position of the occluded front north of the cyclone in Saskatchewan 24 hours later (Figure 52). The wind shift described above appears to be well correlated with the passage of that synoptic feature, although the timing is not clear.

The trajectory that terminated at EDMU at the time of the PAN peak concentration at 24/1400 MST appears in Figure 59. The effect of the wind shift on the air parcel trajectory makes it appear that the city itself was the original source (12 to 14 hours earlier) of the elevated PAN concentration.

In summary, Episode 4, although appearing similar to previous episodes, demonstrates some important differences, including northerly flow just prior to the PAN maximum, generally cloudy skies, and a frontal passage. This description also demonstrates the complexity of the synoptic conditions (split flow) behind Case 6. Whereas Episode 3 was influenced by the approach of a cyclone in the southerly branch of the split flow, Episode 4 occurred after the passage of a front embedded in the northerly branch of the split.

4.6.1.6.5 Case 6, Episode 5, 1983 August 26. After nearly 36 hours with PAN concentrations less than 0.50 ppb, a sudden 1.42 ppb peak occurred at 25/1100 MST (Figure 60). Episode 5 of Case 6 again displayed an asymmetrical record, i.e., sharp maximum followed by slow decrease. This episode was 13 hours in duration, with concentrations exceeding 0.5 ppb from 26/1030 MST to 26/2330 MST.

A major peak in nitrogen oxides concentration of 250 ppb occurred at 0700 MST. As the nitrogen oxides declined to 40 ppb by 1200 MST, ozone and PAN were generated. Ozone concentrations rose from 10 ppb at 0700 MST to 35 ppb at 1400 MST, and maintained these levels

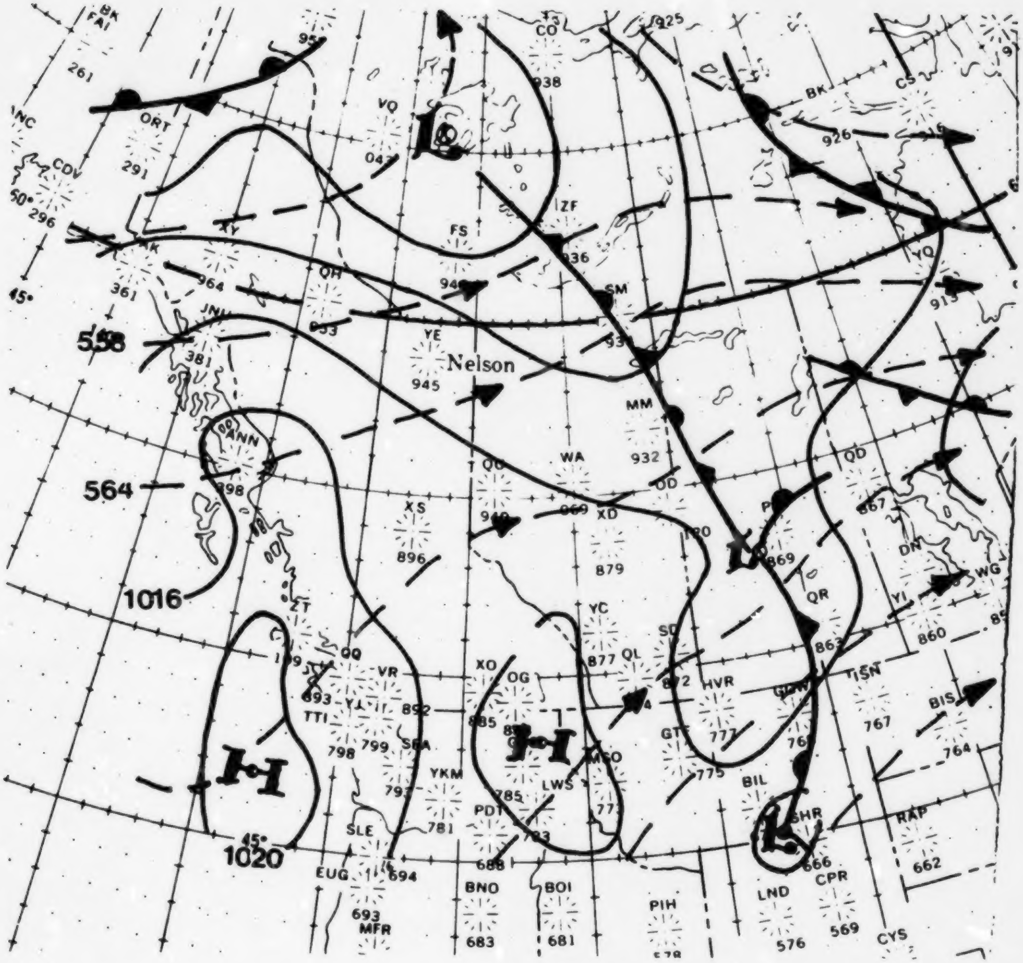

FAI
261
ORT
291
CDV
50°
296
45°
361
558
381
564
1016
1020
45°
VQ
043
CO
938
ZF
FS
936
SM
QH
933
YE
Nelson
945
MM
932
BK
926
CS
YQ
913
WA
QD
XS
896
XD
879
OD
869
QR
863
DN
WG
YI
860
ISN
767
BIS
764
RAP
662
YC
877
QL
HVR
GTF
775
GGW
BIL
SHR
666
CPR
569
LND
576
CYS
PIH
BOI
681
BNO
683
MSO
LWS
PDT
781
YKM
792
SEA
799
TTI
798
VR
OG
XO
885
SLE
EUG
694
693
MFR
688
ANN
398
ZT
QQ

Figure 58. Composite surface and 500 mb analysis for 1983 August 24 at 1700 MST. Case 6, Episode 4. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

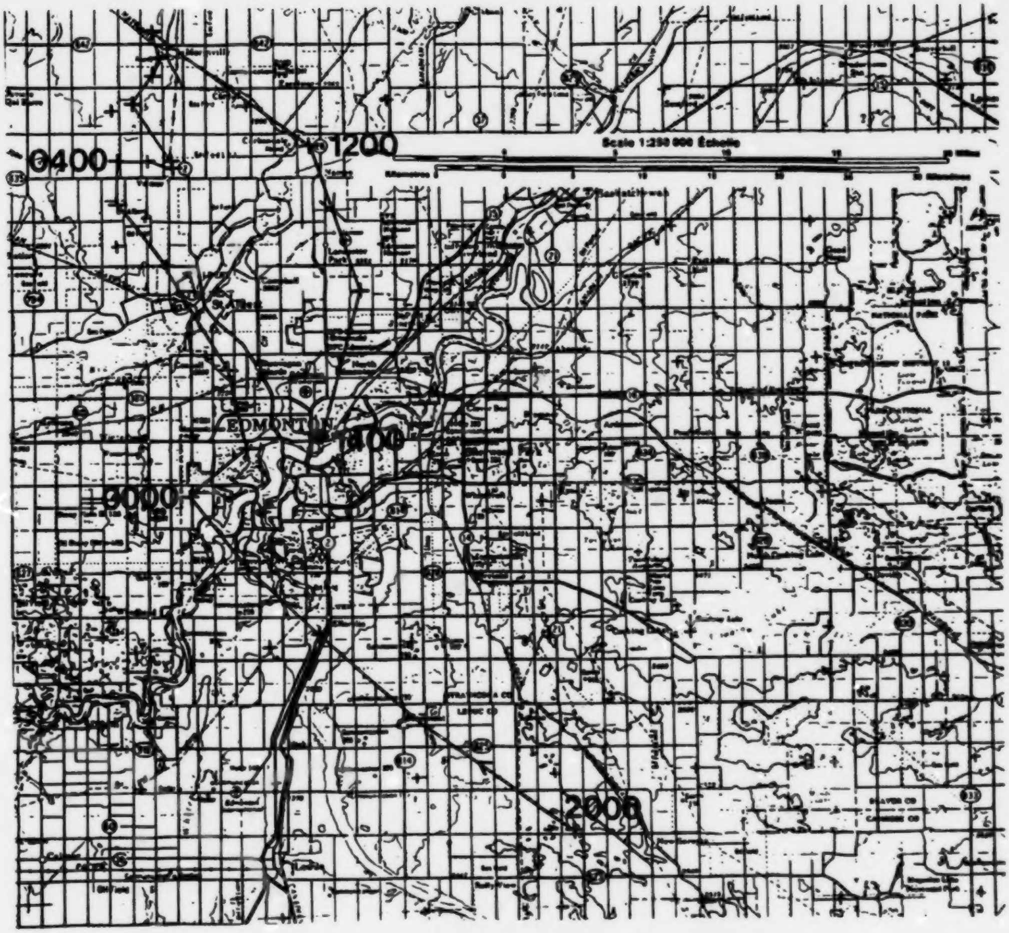

0400
1200
Scale 1:250 000 Échelle
St. Albert
EDMONTON
1400
0000
2000

Figure 59. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1400 MST, 1983 August 24. Case 6, Episode 4. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

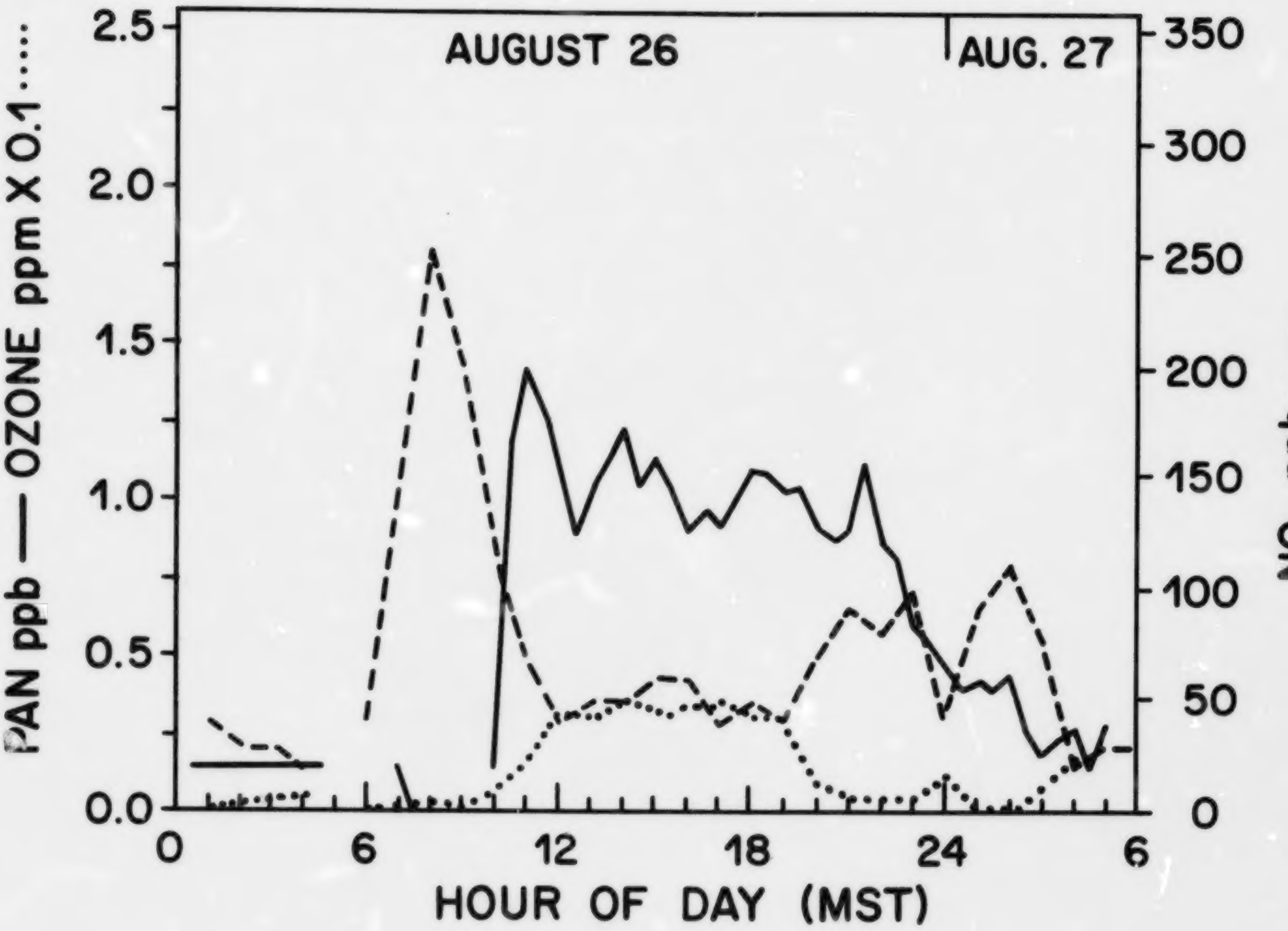


Figure 60. PAN, ozone, and NO_x concentrations in Edmonton, 1983 August 26. Case 6, Episode 5.

until 1900 MST. PAN concentrations gradually declined during this period.

PAN concentrations at Fort Saskatchewan exceeded the detection limit of 0.27 ppb at 0930 MST and remained above that level until readings ceased at 1830 MST (Figure 61). Thus, the behaviour of PAN in Fort Saskatchewan was similar to that in Edmonton (Figure 60). Ozone concentrations in both Edmonton and Fort Saskatchewan followed the usual diurnal trend, but in Fort Saskatchewan the maximum concentration was 85 ppb, whereas the concentration in Edmonton reached only 35 ppb. No NO_x data for Fort Saskatchewan was available, but ozone concentrations in Edmonton were likely suppressed by nitrogen oxides.

The early morning hours of August 26 were marked with very low visibility due to fog and haze (Figure 62). This condition improved rapidly after 26/0500 MST. Visibility generally exceeded 25 km after 26/1100 MST, the time of the PAN peak. Sky cover during the period typically exceeded 60%, with cumulus and thin cirrus clouds. Clouds increased in the late afternoon as shower activity developed over the area. Mixing depths, as indicated by cumulus cloud bases, ranged from about 100 m at the time of the PAN peak to an afternoon maximum of more than 1600 m. A well-defined heat island existed over Edmonton by the end of the episode when YXD-YEG temperature differences reached $8C^o$. Surface winds varied from light southwesterly to light southeasterly. About the time of the end of the PAN episode, winds became very light northerly and visibility began to decrease again in haze. It should be noted that the preceding (clean) day was characterized by overcast skies, more extensive shower activity, and northerly winds.

The large-scale meteorological conditions are shown in Figure 63. The TROWAL associated with the shower activity on August 25 had moved eastward. At the time of Episode 5, central Alberta was under the influence of weak surface ridging ahead of another TROWAL located in western Alberta at 25/1700 MST. Aloft, weak southwesterly surface flow in the vicinity of a weak short wave ridge influenced the area.

The surface air trajectory that ended at EDMU at the time of the PAN maximum is shown in Figure 64. The influence of the weak synoptic regime is clearly indicated. In fact, a review of all

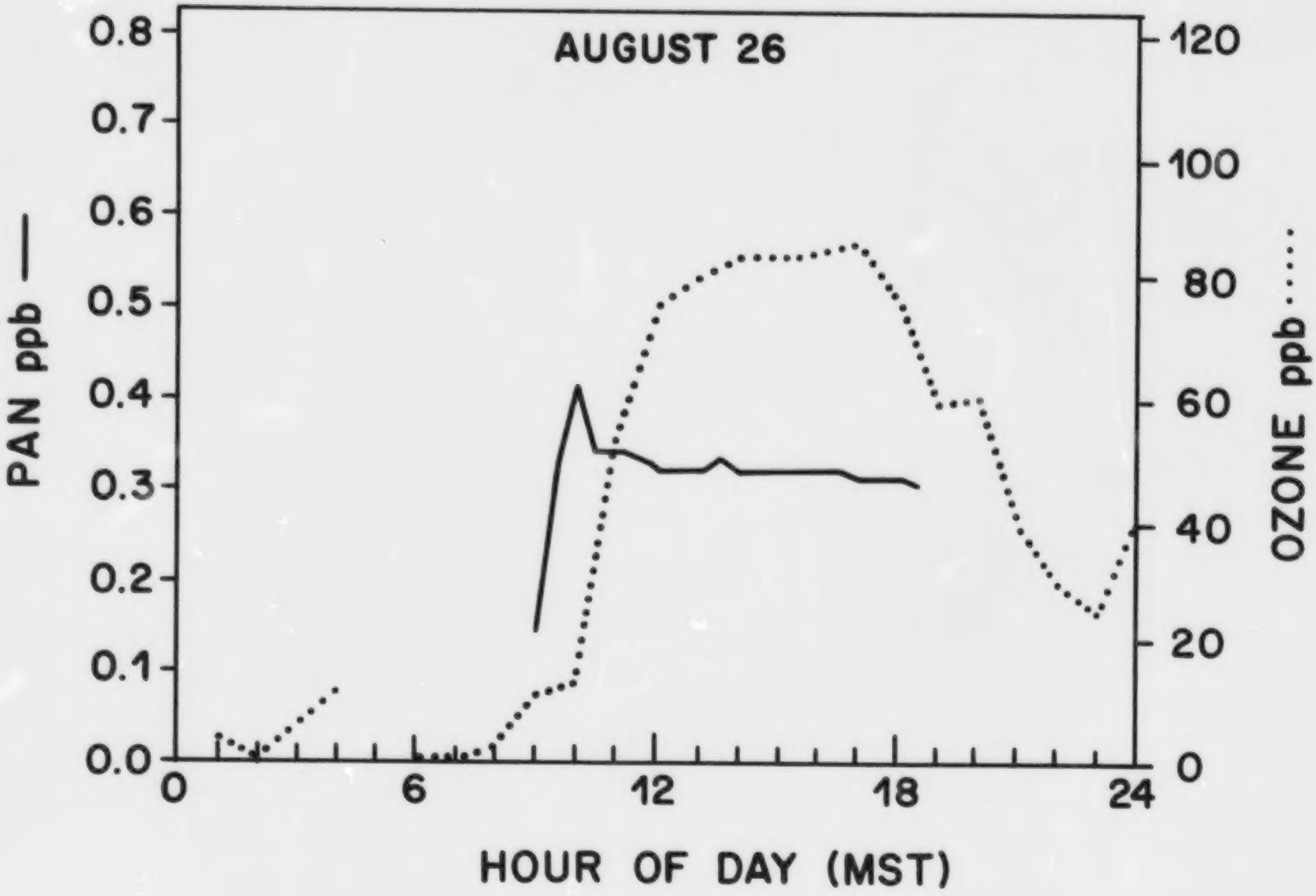


Figure 61. PAN and ozone concentrations in Fort Saskatchewan, 1983 August 26. Case 6, Episode 5.

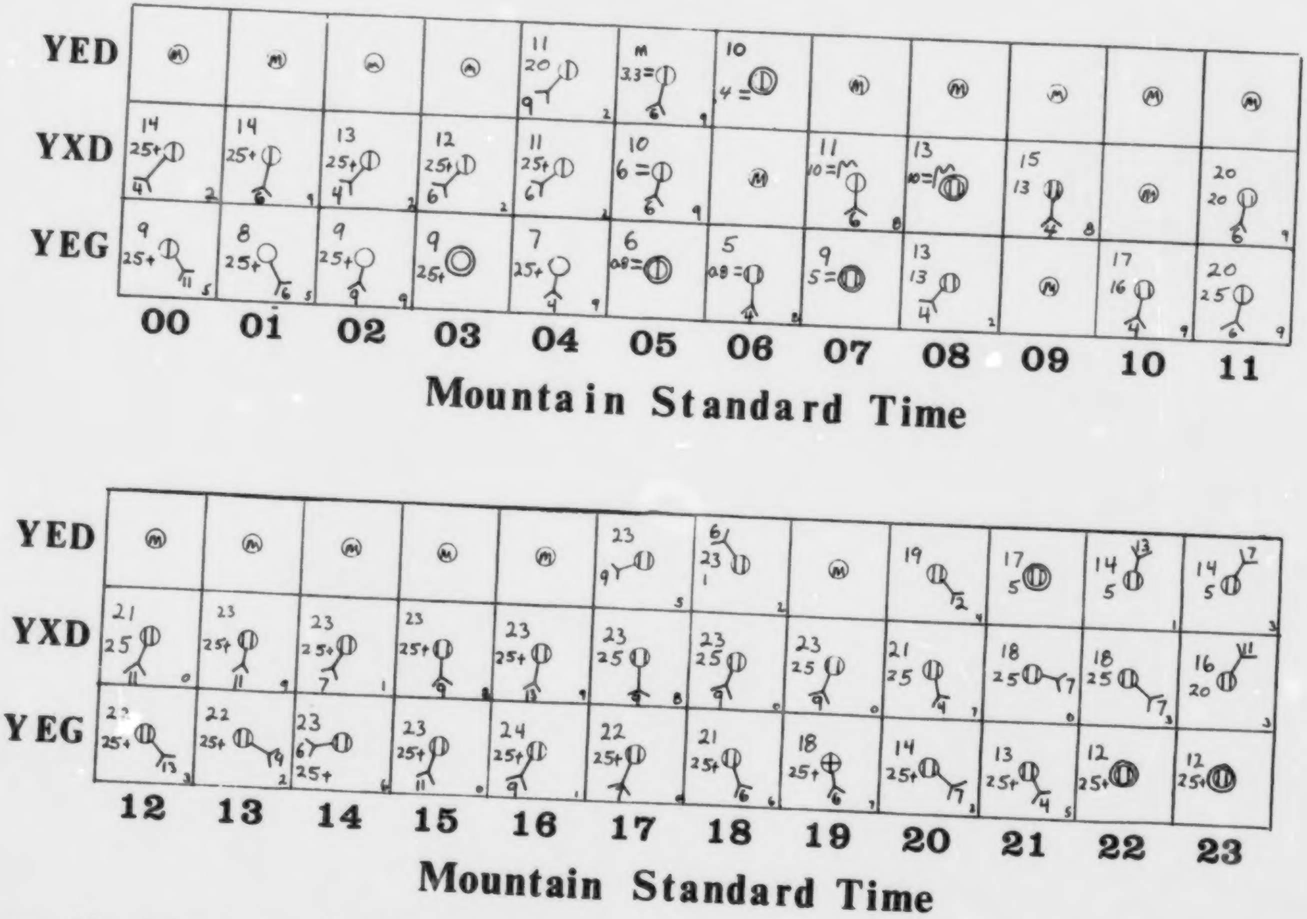

YED
YXD
YEG
00 01 02 03 04 05 06 07 08 09 10 11
Mountain Standard Time
YED
YXD
YEG
12 13 14 15 16 17 18 19 20 21 22 23
Mountain Standard Time

Figure 62. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1983 August 26. Case 6, Episode 5. Explanation of symbols appears in Table 2.

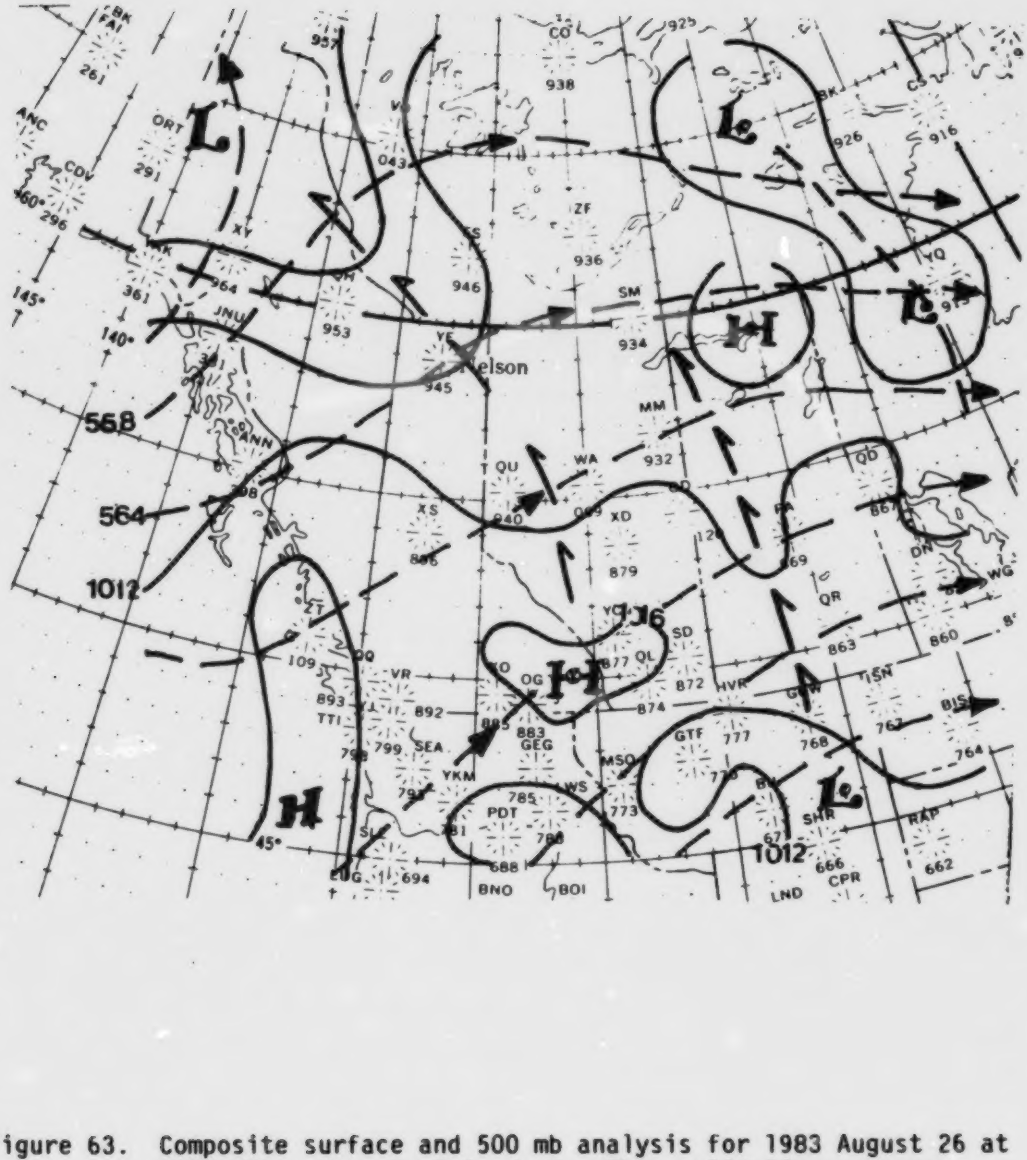


Figure 63. Composite surface and 500 mb analysis for 1983 August 26 at 1700 MST. Case 6, Episode 5. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

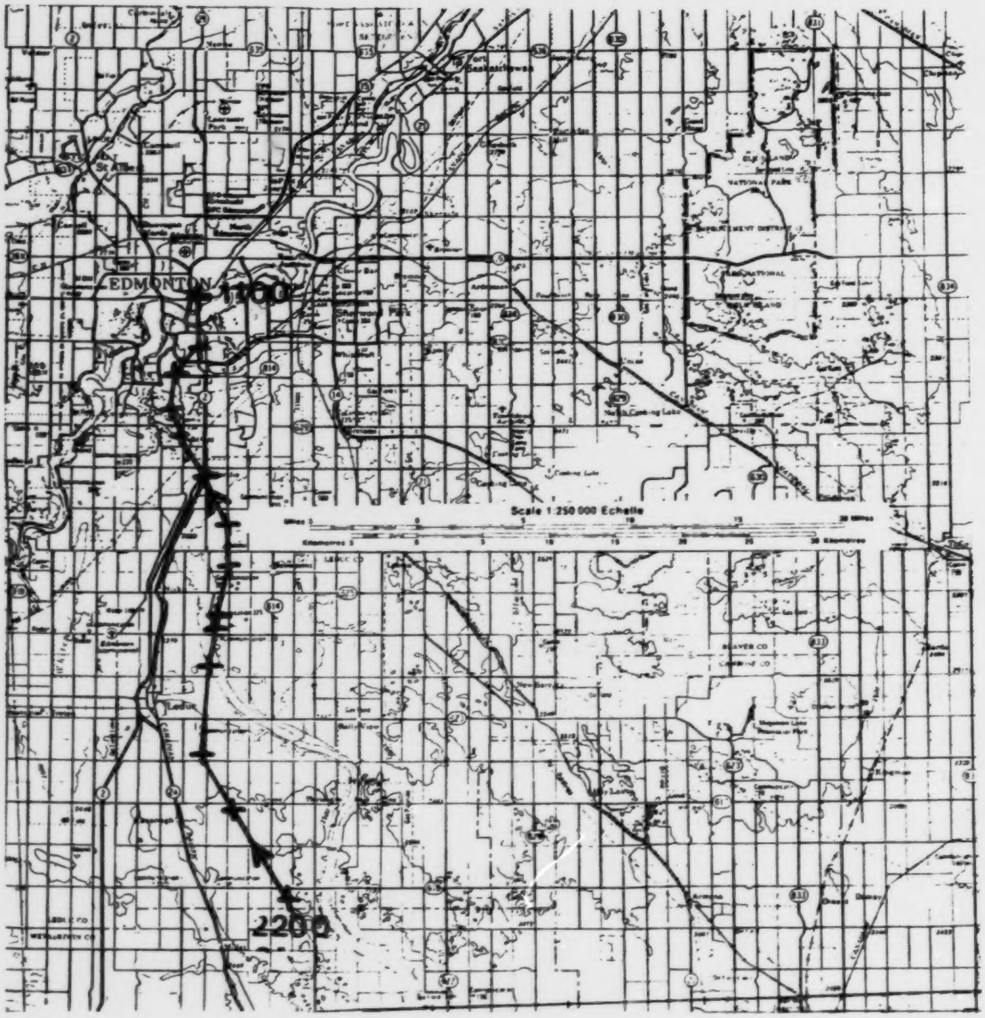

EDMONTON
1100
2200
Scale 1:250 000 Echelle
Leduc

Figure 64. Air parcel trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1100 MST, 1983 August 26. Case 6, Episode 5. Hourly positions along the trajectory are indicated by crosses, and the trajectory direction by arrowheads.

trajectory computations for Case 6 shows a strong and systematic influence of the passage of weak synoptic systems on the regional windfield.

4.6.1.7 Case 7, 1984 April 19 to 21. Case 7 was selected for study because it was one of only two periods where measurements of PAN were made at both EDMU and Fort Saskatchewan when concentrations were relatively high. Three PAN episodes occurred during Case 7 (Table 10, Figure 65). At Edmonton, a sharp peak was recorded late in the afternoon on April 19, after two days where peak values were 0.61 ppb or less. PAN values fell rapidly during the night of April 19-20 to values of less than 0.15 ppb. Beginning midmorning on April 20, background PAN concentrations at EDMU increased to values above 0.5 ppb and remained high until the afternoon of 1984 April 21, with episode peaks at 20/2000 MST and 21/1030 MST. PAN concentrations at Fort Saskatchewan (Figure 66) generally paralleled those at EDMU, but with two differences: (1) EDMU PAN values usually exceeded Fort Saskatchewan values and (2) the phase of the Fort Saskatchewan PAN record tended to lag EDMU by as much as two hours.

The upper air flow during Case 7 was characterized by an intense block over North America near 95°W longitude. At 20/1700 MST a distinct split in the midtropospheric air flow had developed along the west coast near latitude 50°N. Under these conditions, Alberta was generally under the influence of southerly winds aloft (SW-SE), while at the surface a cool air mass and an associated ridge of high pressure prevailed.

4.6.1.7.1 Case 7, Episode 1, 1984 April 19. Episode 1, as mentioned earlier, was of brief duration. Significant PAN concentrations occurred from 19/1530 MST to 19/1800 MST at EDMU with a peak of 1.03 ppb at 19/1730 MST (Figure 65). At Fort Saskatchewan, PAN values peaked at only 0.20 ppb at about the same time as the EDMU peak. Also, the Fort Saskatchewan peak was much flatter than the EDMU peak (Figure 66).

Ozone concentrations in Edmonton declined from 32 ppb at 0100 MST to 1 ppb by 2400 MST. No major peaks in ozone occurred. The same trend was found at Fort Saskatchewan with values declining from 38 ppb at 0100 MST to 15 ppb at 1800 MST, rising briefly to 25 ppb at

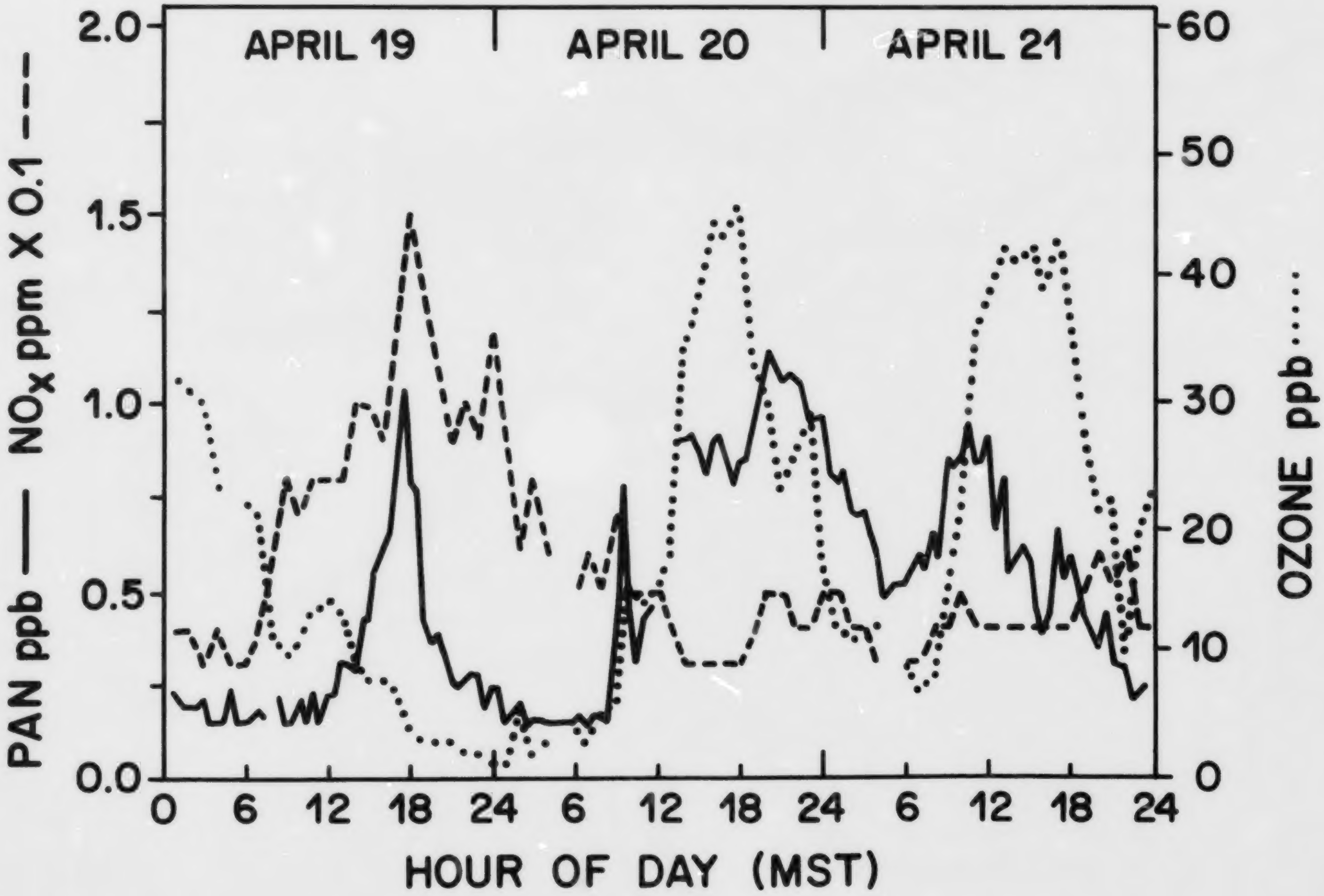


Figure 65. PAN, ozone, and NO$_x$ concentrations in Edmonton, 1984 April 19, 20, and 21. Case 7, episodes 1, 2, and 3.

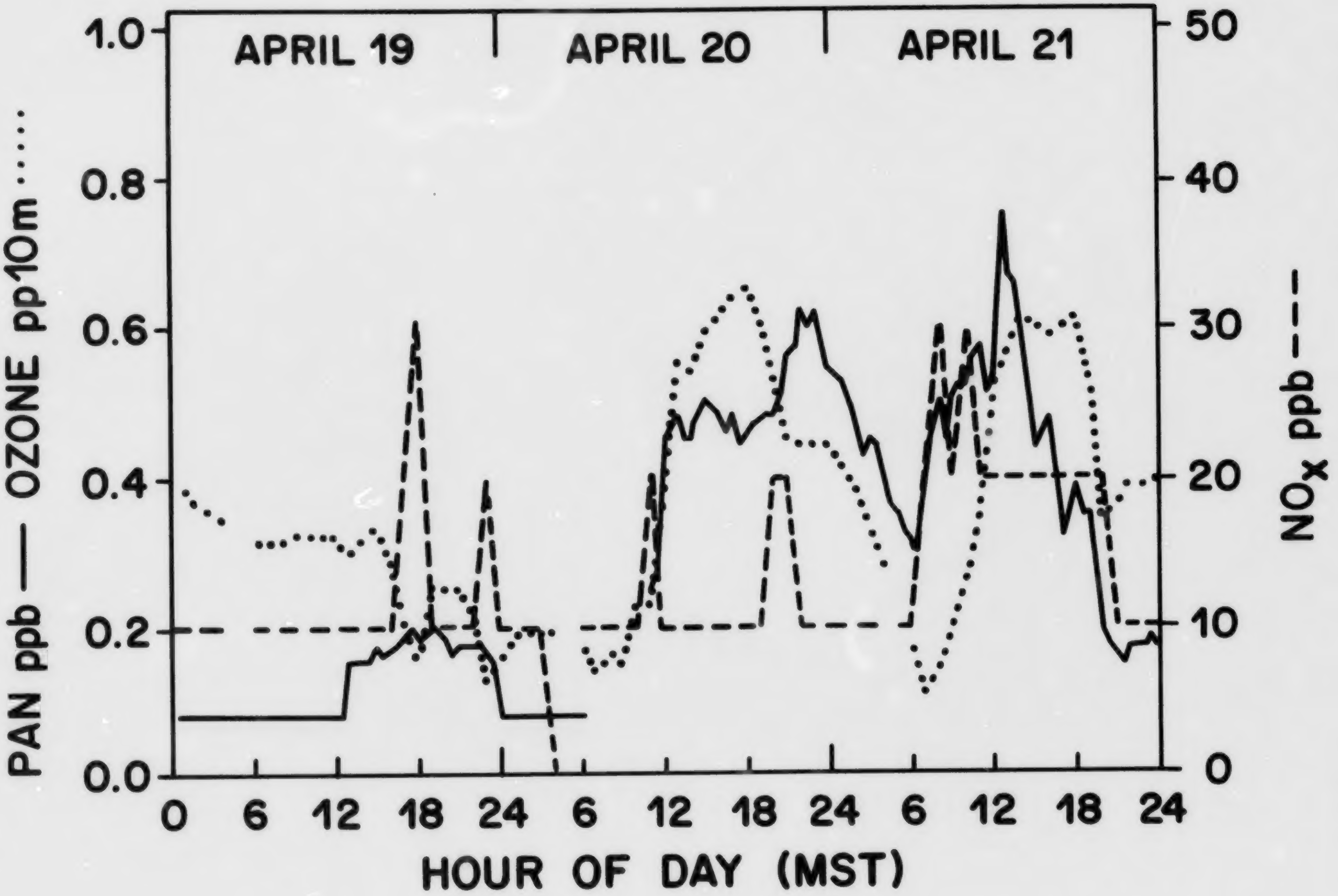


Figure 66. PAN, ozone, and NO_x concentrations in Fort Saskatchewan, 1984 April 19, 20, and 21. Case 7, episodes 1, 2, and 3.

1900 MST and then declining to 1.3 ppb at 2300. Nitrogen oxides in Edmonton rose from a low value of 30 ppb at 0600 MST to a high of 150 ppb at 1800 MST. The PAN peak occurred at approximately the same time as the maximum in nitrogen oxides. In Fort Saskatchewan, the nitrogen oxides were uniformly low at 10 ppb until 1800 MST, when they reached a maximum of 30 ppb. The maximum PAN concentration of 0.20 ppb occurred at 1730 MST. In summary, PAN and nitrogen oxides reached maximum concentrations at the same time in both Edmonton and Fort Saskatchewan.

Airport observations near Edmonton (Figure 67) reflected the influence of the intensifying ridge aloft and the eastward movement of a weak ridge at the surface (Figure 68). Rain, overcast skies, and generally northerly to northwesterly surface winds in the morning hours gave way to light easterly flow and decreasing low clouds on the evening of the April 19. The Stony Plain Sounding for 19/1700 MST indicated a mixing depth of about 800 m at 19/1700 MST, i.e., near the time of the peak PAN concentration. The maximum temperature (8°C) occurred about the same time.

The influence of the changing synoptic condition on trajectories ending at EDMU and Fort Saskatchewan at the time of the PAN maxima are presented in Figure 69. It appears that a few hours of nearly stagnant conditions occurred NE of both sites as the surface ridgeline moved eastward.

4.6.1.7.2 Case 7, Episode 2, 1984 April 20. Beginning about 20/0900 MST, PAN values at EDMU (Figure 65) increased irregularly to a maximum of 1.12 ppb at 20/2000 MST. Fort Saskatchewan showed similar behaviour, although its absolute peak (0.62 ppb) was not reached until 20/2200 MST (Figure 66).

Ozone concentrations in Edmonton followed a normal diurnal pattern, increasing from an overnight low of 10 ppb at 0100 MST to a high of 46 ppb at 1800 MST before declining. Nitrogen oxides declined irregularly from a high of 90 ppb at 0100 MST to a low of 30 ppb at 1400 MST. Concentrations increased slowly from 1900 MST onward; thus, the peak in the ozone concentrations occurred during the minimum in nitrogen oxides concentrations.

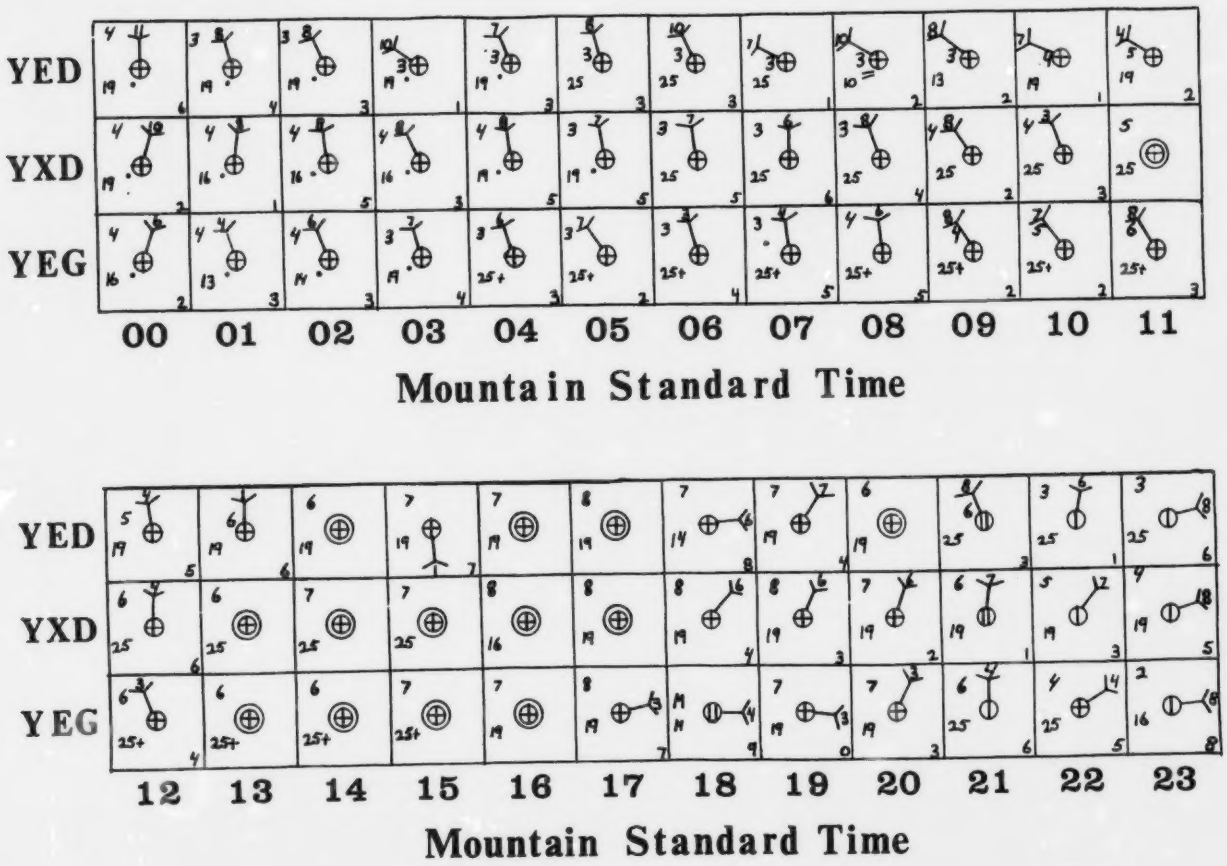


Figure 67. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1984 April 19. Case 7, Episode 1. Explanation of symbols appears in Table 2.

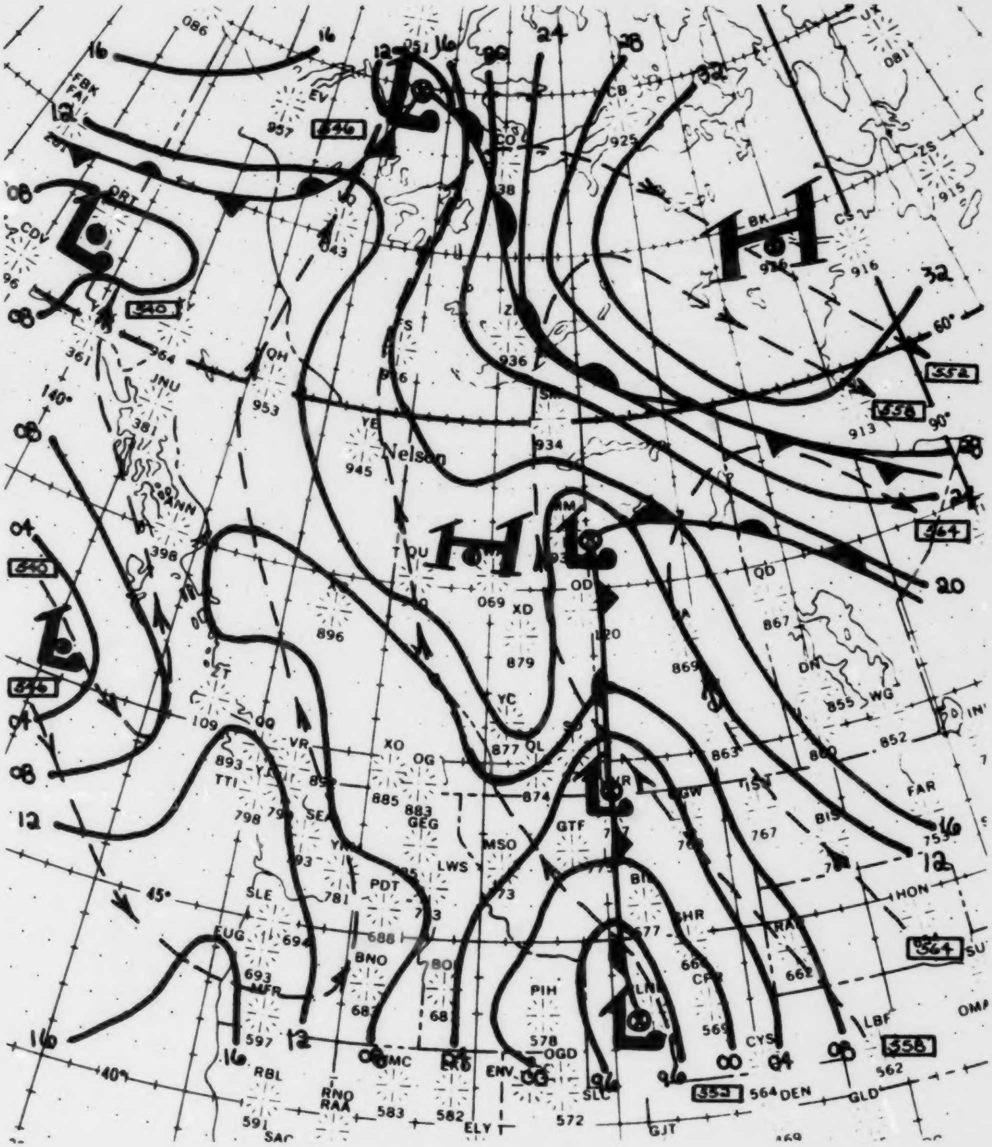

Nelson
45°
40°
60°
140°
90°
FBK
FAI
CDV
JNU
ANN
SLE
EUG
MFR
RBL
SAC
BNO
RNO
RAA
PDT
GEG
LWS
MSO
GTF
BOI
PIH
OGD
SLC
ELY
GJT
DEN
CYS
LBF
GLD
OMA
HON
FAR
BIS
WMC
ENV
540
552
558
564
556

Figure 68. Composite surface and 500 mb analysis for 1984 April 19 at 1700 MST. Case 7, Episode 1. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

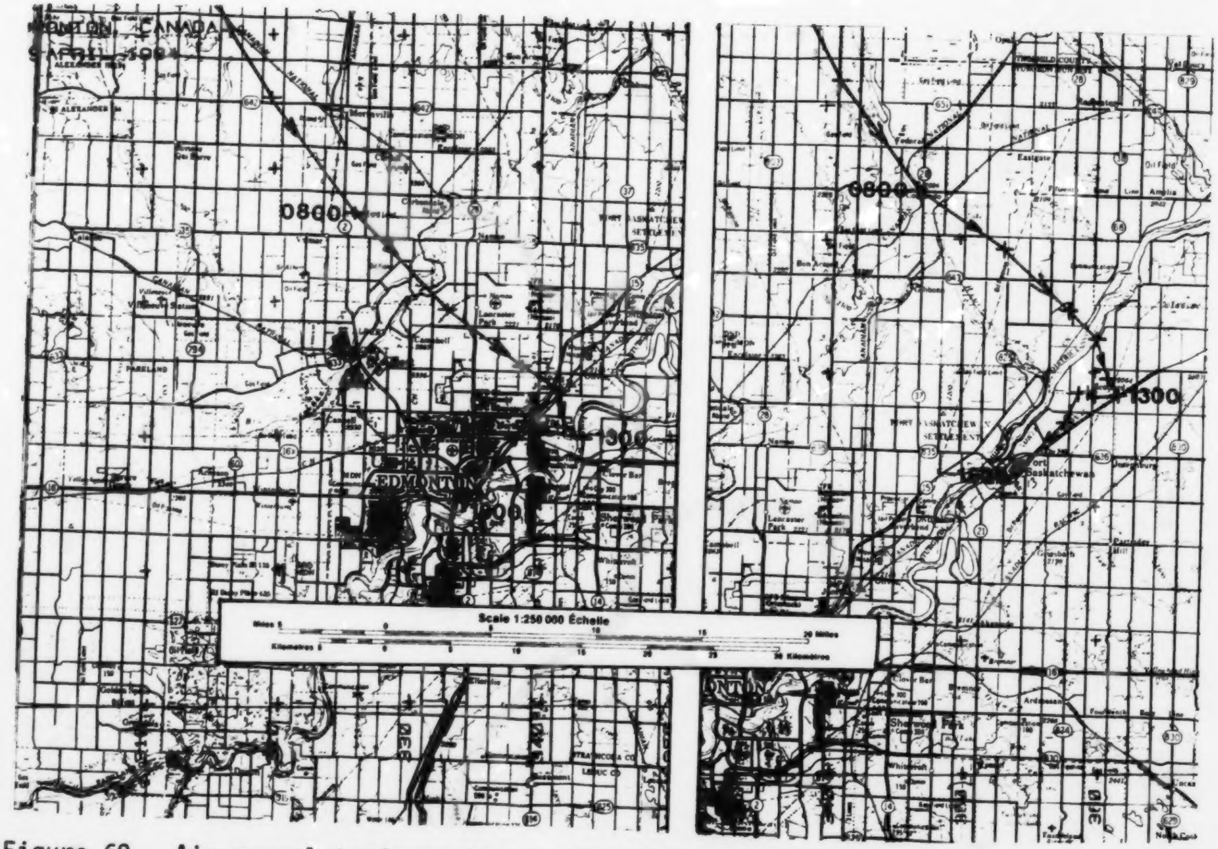

0800
1300
0800
1300
EDMONTON
Fort Saskatchewan
Scale 1:250 000 Échelle

Figure 69. Air parcel trajectories at 1800 MST, 1984 April 19. Case 7, Episode 1. LEFT: Trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU). RIGHT: Trajectory terminating at Fort Saskatchewan. Hourly positions along the trajectories are indicated by crosses, and the trajectory directions by arrowheads.

At Fort Saskatchewan ozone rose from a minimum of 14 ppb at 0700 MST to a maximum of 65 ppb at 1800 MST. Nitrogen oxides were uniformly low during this period, ranging from 10 ppb to 20 ppb.

At the three airport sites near Edmonton (Figure 70), the northerly surface flow weakened near sunrise, then veered to SSE during the late morning, reaching a maximum of 25 km·h^{-1} with gusts between 20/1400 and 20/1800 MST. With the exception of a brief increase in high cloudiness and a slight visibility restriction with ground fog just after sunrise, scattered cloud and good visibility prevailed throughout the day. It should be noted that the initial PAN increase described above (Figure 65) corresponds in time with the decreasing high cloudiness and increasing visibility in the late morning. Maximum temperatures (18^{o}C) were 10C^{o} warmer than the previous day. Similarly, the maximum mixing depth more than doubled to about 1700 m.

Surface and upper air features for 20/1700 MST are shown in Figure 71. The anticyclonic influence of the block centred at 500 mb over Manitoba had continued to expand westward over the previous 24 hours with rising 500 mb heights at Edmonton. Simultaneously, the approach of a series of short wave troughs across British Columbia resulted in a reversal of the surface pressure gradient over the western provinces, causing moderate southerly flow near Edmonton as noted in the early discussions of the airport winds.

Trajectories of air arriving at EDMU and Fort Saskatchewan at the time of their maximum PAN observations (20/2000 MST and 20/2200 MST, respectively) are shown in Figure 72. The explanation of the two-hour lag between the EDMU and Fort Saskatchewan PAN observations is not clear from the trajectory configurations. The air that arrived at Fort Saskatchewan at 20/2200 MST was well to the southeast of Edmonton at 20/2000 MST (i.e., at the time of the EDMU maximum).

4.6.1.7.3 Case 7, Episode 3, 1984 April 21. PAN values for this day decreased from the maximum observed late on the previous day to a minimum of 0.48 ppb near sunrise (Figure 65). Thereafter, concentrations again rose to maximum of 0.93 ppb at 21/1030 MST in Edmonton.

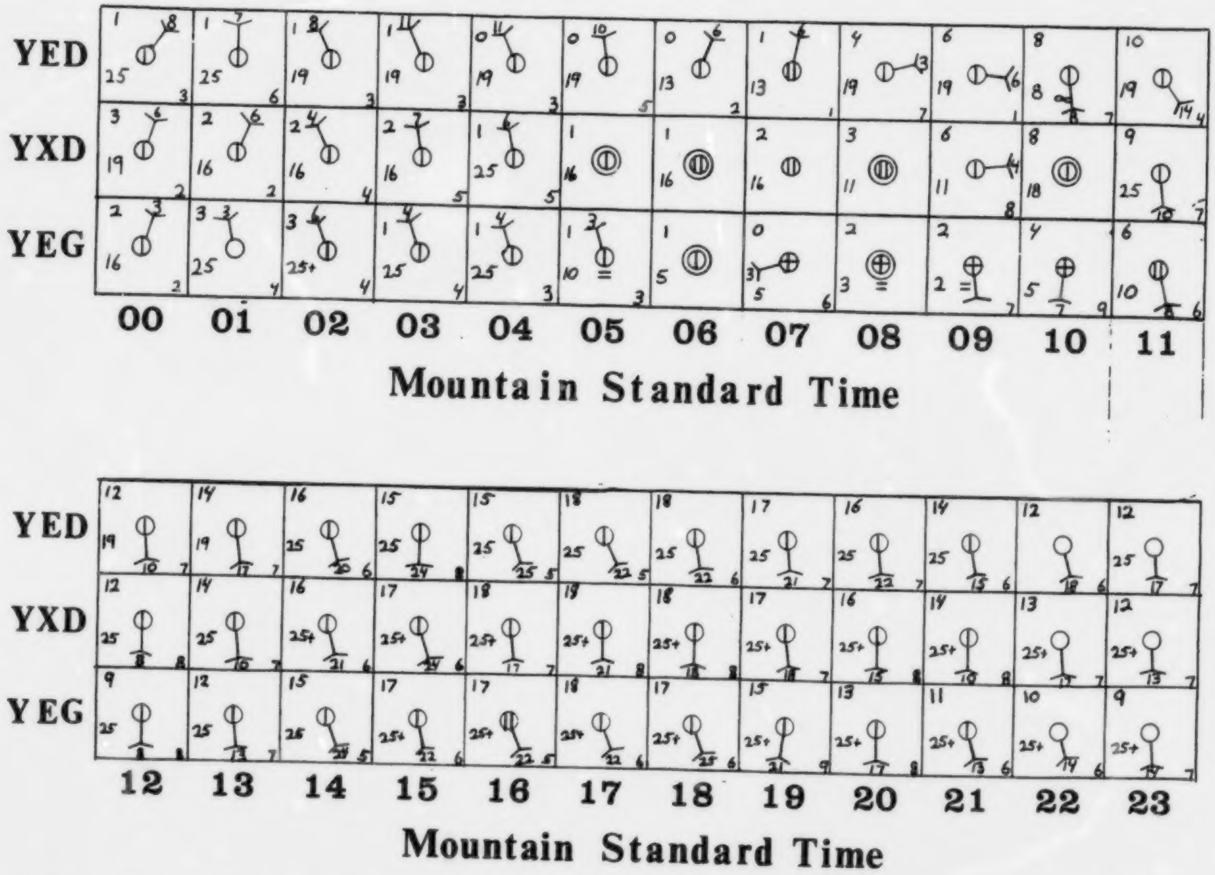


Figure 70. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1984 April 20. Case 7, Episode 2. Explanation of symbols appears in Table 2.

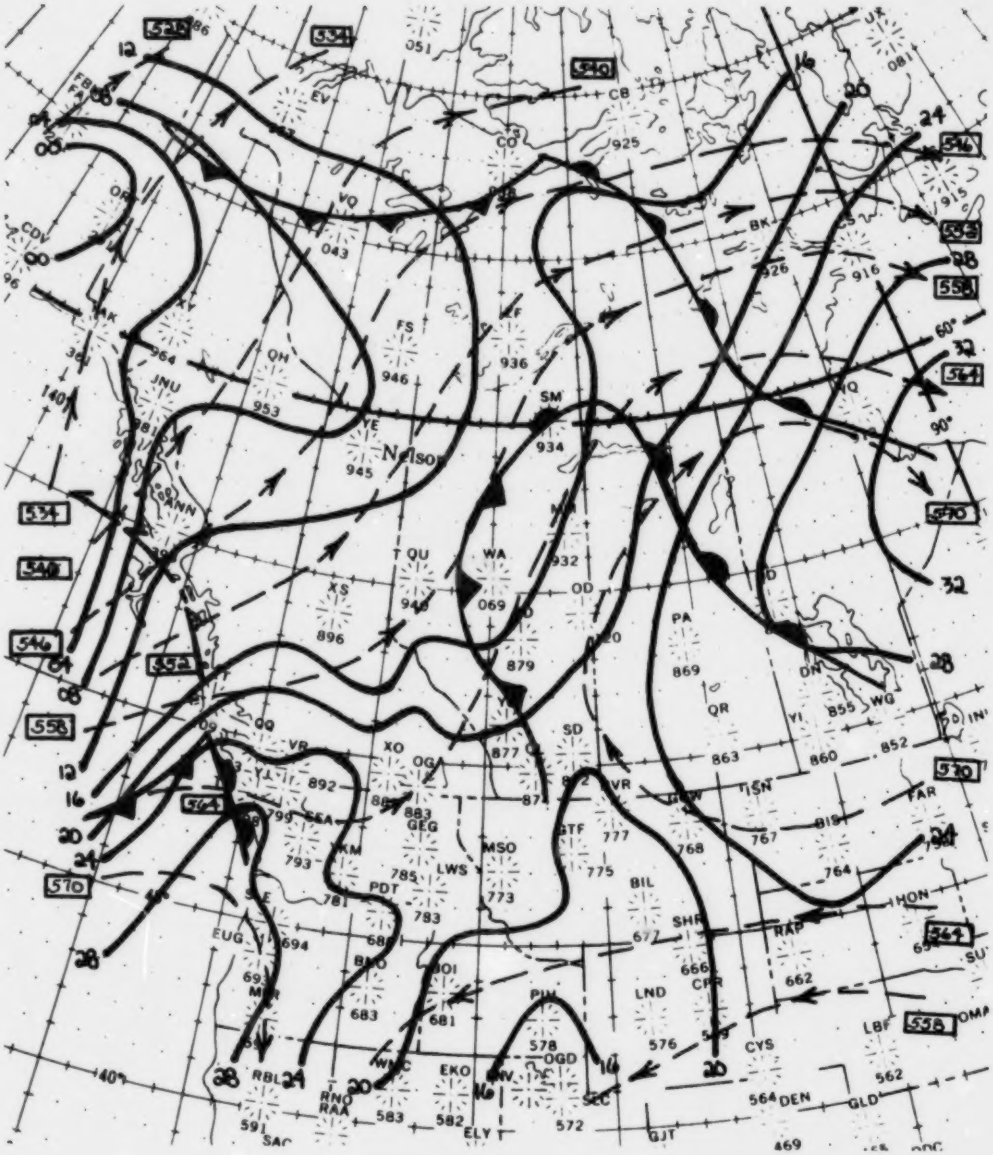

528
534
540
546
552
558
564
570
12
08
04
00
16
20
24
28
32
Nelson
60°
90°
140°
40°
SM
QU
WA
SEA
GEG
LWS
MSO
BIL
SHR
RAP
BIS
FAR
HON
CYS
DEN
LBF
OMA
GLD
GJT
EKO
ELY
RNO
SAC
EUG
MFR
BOI
PIH
OGD
LND
CPR
YKM
PDT
BNO
WMC
GGW
ISN
GTF
JNU
ANN
YAK

Figure 71. Composite surface and 500 mb analysis for 1984 April 20 at 1700 MST. Case 7, Episode 2. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

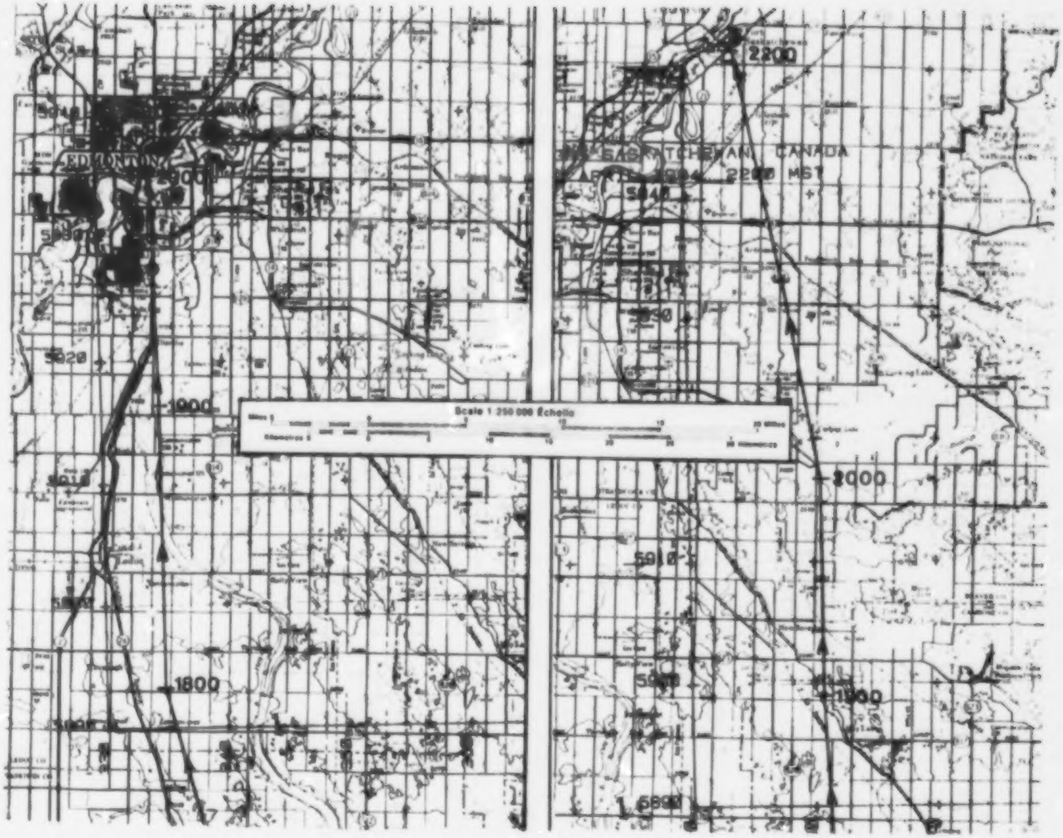

EDMONTON
2000
1900
1800
5020
Scale 1:250 000 Échelle
2200
SASKATCHEWAN, CANADA
2200 MST
2000
1900
5910
6800

Figure 72. Air parcel trajectories, 1984 April 20. Case 7, Episode 2. LEFT: Trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 2000 MST. RIGHT: Trajectory terminating at Fort Saskatchewan at 2200 MST. Hourly positions along the trajectories are indicated by crosses, and the trajectory directions by arrowheads.

At Fort Saskatchewan, PAN concentrations rose from an overnight low of 0.30 ppb to a maximum of 0.75 ppb at 1230 MST. By 1830 MST, PAN values were below 0.5 ppb at both locations (Figure 66).

Ozone concentrations in Edmonton rose from 7 ppb at 0700 MST to 42 ppb by 1300 MST, remained at this level until 1800 MST, and then started to decline. Nitrogen oxide concentrations ranged from 30 to 60 ppb. In Fort Saskatchewan, ozone concentrations rose from a minimum of 11 ppb at 0700 MST to a maximum of 61 ppb at 1400 MST. Ozone declined in the evening from 52 ppb at 1900 MST to 35 ppb at 2000 MST. Nitrogen oxides ranged from 10 ppb to 30 ppb.

It is noted that, as on earlier days, EDMU and Fort Saskatchewan records tended to agree, but with an apparent lag in both the maxima and minima in the record at the latter location. Also, when considering the entire Case 7, although EDMU concentrations were greater than those at Fort Saskatchewan by a factor of 2 or more, the Fort Saskatchewan maxima increased from episodes 1 to 3, while the EDMU peak values decreased, especially from the second to the third episode.

At the airport weather stations (Figure 73), southerly surface winds weakened through midday, shifting to westerly and northwesterly in the afternoon. The wind shift and general increase in cloudiness through the day corresponded with the passage of the weak surface front and upper air trough located in southeastern British Columbia (Figure 71). It is estimated that the mixing depth was restricted to about 1 km at EDMU at the time of the PAN maximum, rapidly increasing after that time to more than 2 km by 21/1700 MST, when surface temperatures reached 20°C.

The trajectories that terminated at the time of peak concentrations at EDMU (21/1030 MST) and at Fort Saskatchewan (21/1230 MST) are presented in Figure 74. The changing pressure patterns are reflected in the shift of the trajectory directions from southerly to southwesterly at 21/0700 MST. A brief stagnation occurred in both trajectories between 21/1000 MST and 21/1100 MST.

The meteorological conditions for Episode 3 of Case 7 suggest that the PAN maxima were associated with air that previously had stagnated over or near the city of Edmonton. The rapid decrease of PAN in the afternoon is apparently tied to increased ventilation with clean

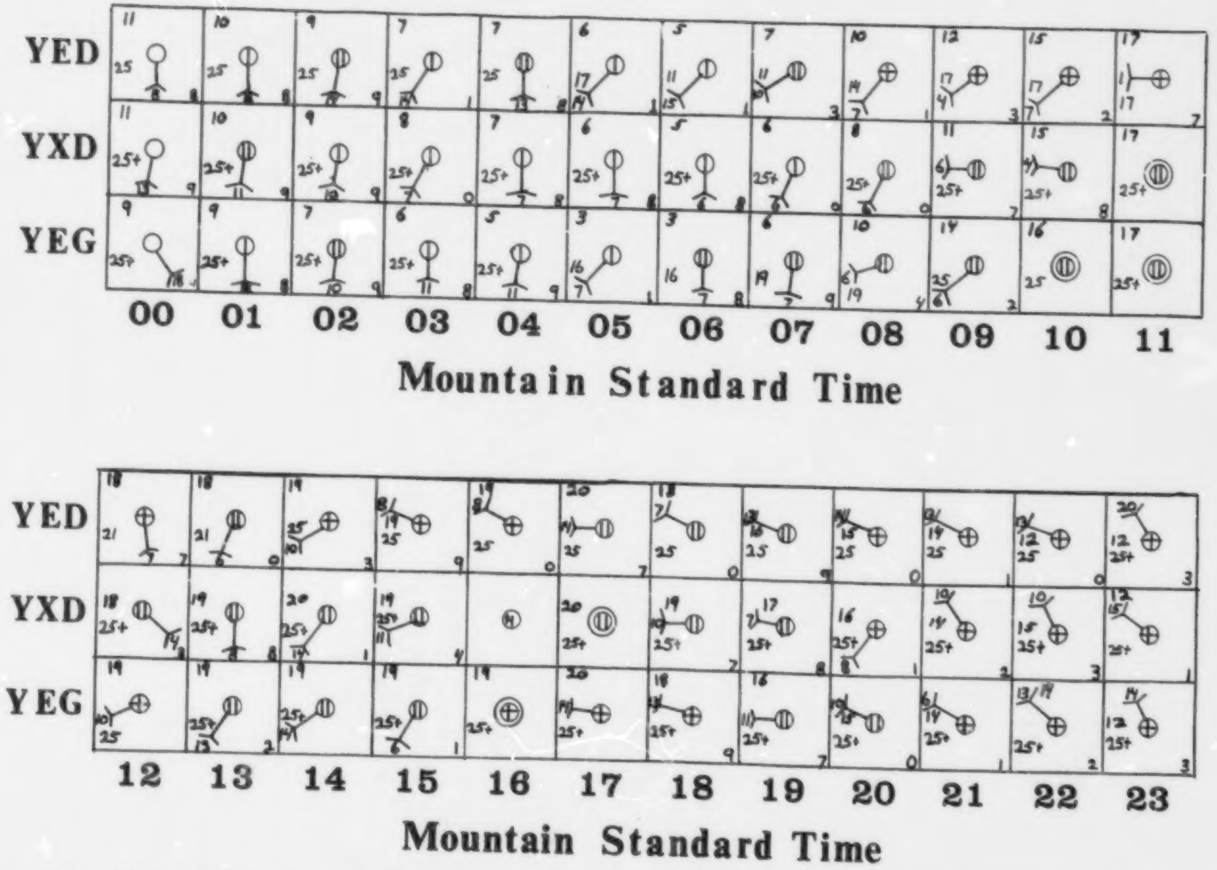

YED
YXD
YEG
00
01
02
03
04
05
06
07
08
09
10
11
Mountain Standard Time
YED
YXD
YEG
12
13
14
15
16
17
18
19
20
21
22
23
Mountain Standard Time

Figure 73. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1984 April 21. Case 7, Episode 3. Explanation of symbols appears in Table 2.

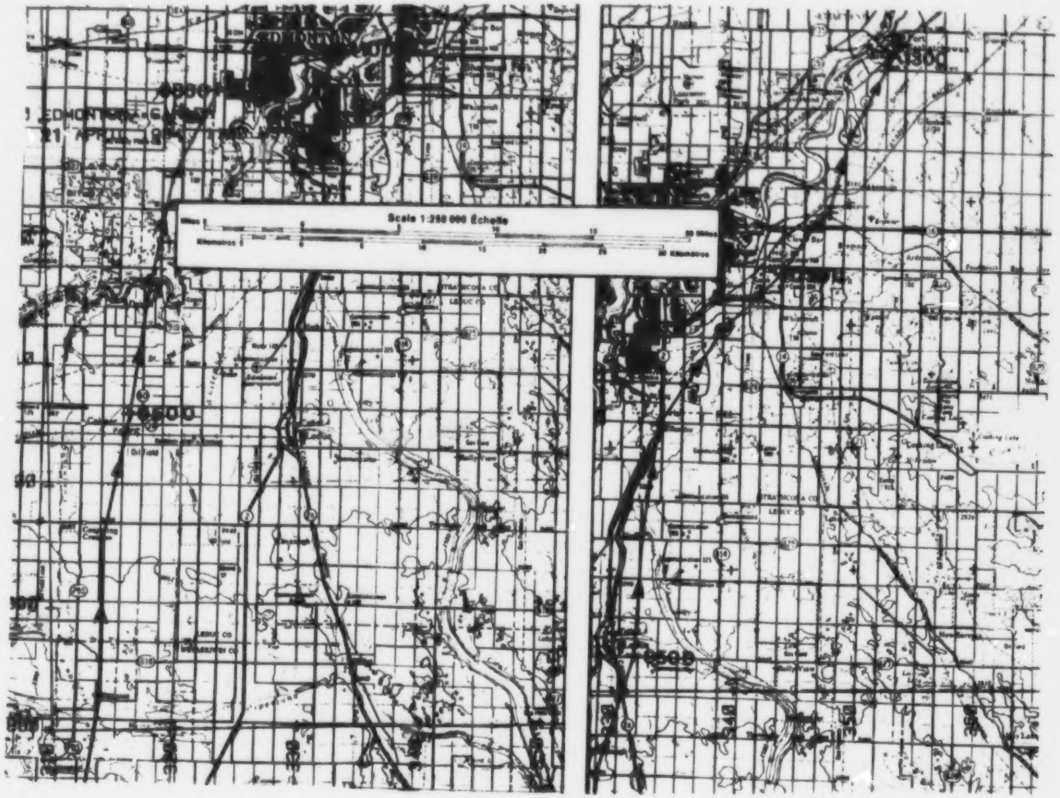

EDMONTON
21 APRIL
Scale 1:250 000 Échelle
1300
0500

Figure 74. Air parcel trajectories, 1984 April 21. Case 7, Episode 3. LEFT: Trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU) at 1100 MST. RIGHT: Trajectory terminating at Fort Saskatchewan at 1300 MST. Hourly positions along the trajectories are indicated by crosses, and the trajectory directions by arrowheads.

air from the northwest, increased cloudiness (decreased direct radiation), and increased mixing depth as a weak front passed the area.

4.6.1.8 Case 8, 1984 April 27 to 28. As in Case 7, simultaneous PAN observations were again made at EDMU and at Fort Saskatchewan. Case 8 consists of two PAN episodes (Table 10, figures 75 and 76), with maxima at both locations in the afternoon and evening of 1984 April 27 and in the morning of April 28. As in Case 7, PAN concentrations at EDMU exceeded those at Fort Saskatchewan, although the phase differences noted in Case 7 were not a clear feature of the PAN records in the present case.

Synoptic patterns over Alberta during Case 8 were controlled by an upper level, high amplitude ridge located near 135°W longitude. This condition produced northerly 500 mb flow during the period in question.

4.6.1.8.1 Case 8, Episode 1, 1984 April 27. Episode 1 began as PAN increased soon after sunrise on April 27 (Figure 75). The highest EDMU PAN value of the episode was not reached until 27/1930 MST (2.29 ppb), and two secondary peaks occurred earlier in the day at 0830 MST (0.89 ppb) and 1430 MST (2.12 ppb).

At Fort Saskatchewan, PAN concentrations ranged from 20% to 50% of the EDMU values, with the greatest differences occurring at the time of the respective maxima. The Fort Saskatchewan record also showed morning and evening maxima at 27/0830 MST (0.35 ppb) and 27/1730 MST (0.44 ppb) (Figure 76). However, the early afternoon maximum seen at EDMU was not evident. Episode 1 ended with the early morning minimum in PAN concentrations on April 28 (Figure 75).

Figure 77 shows the synoptic conditions valid at the end of Episode 1. The generally northerly flow at 500 mb represents a "steering current," which brought southward the TROWAL located through Alberta at 28/0500 MST. The weak ridge over southeastern Alberta, just ahead of the TROWAL shown in Figure 77, was responsible for the generally weak flow over the province earlier in the day.

Ozone distributions in Edmonton showed normal diurnal behaviour rising from a minimum of less than 0.5 ppb at 0800 MST to a

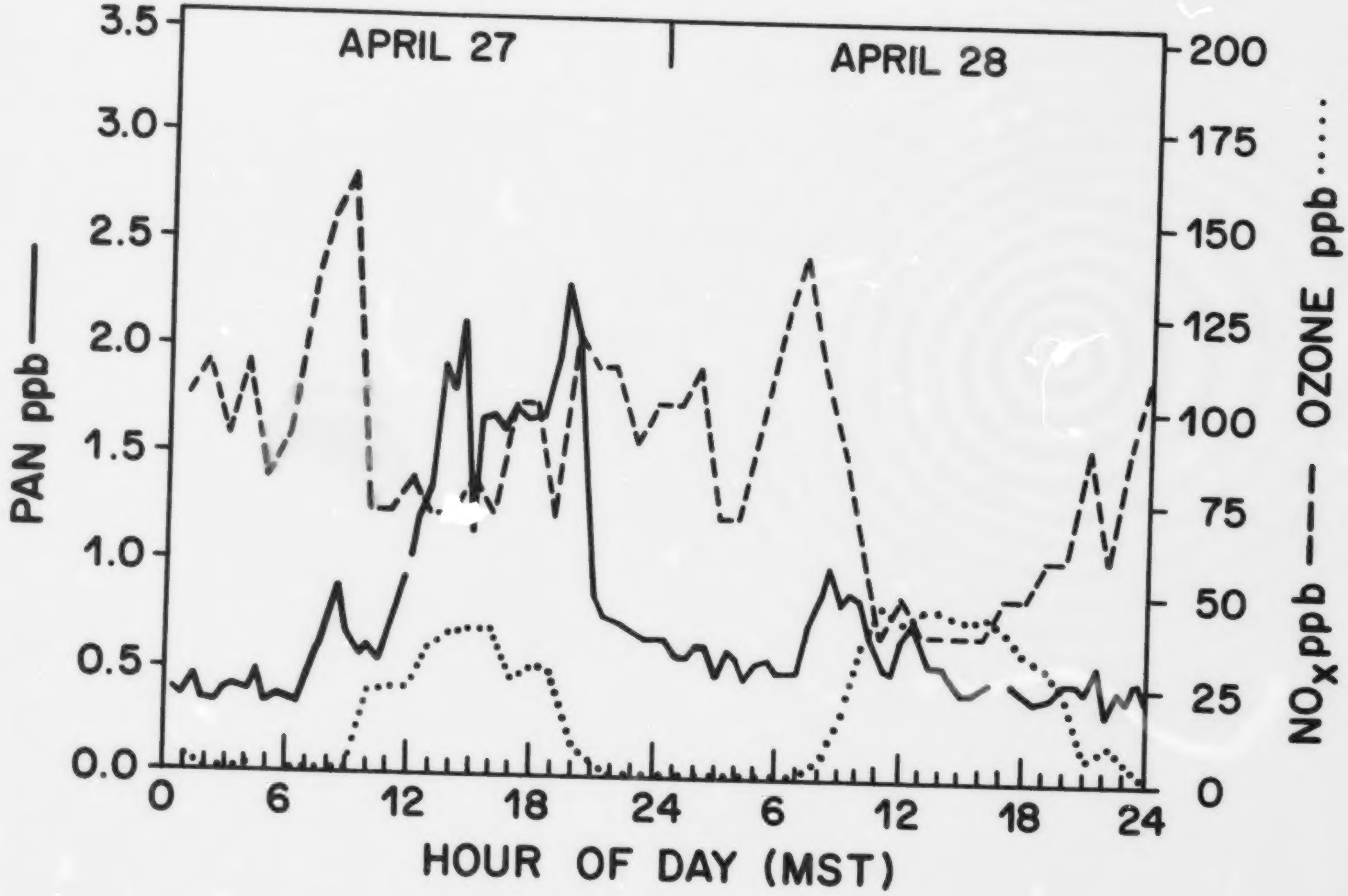


Figure 75. PAN, ozone, and NO$_x$ concentrations in Edmonton, 1984 April 27 and 28. Case 8, episodes 1 and 2.

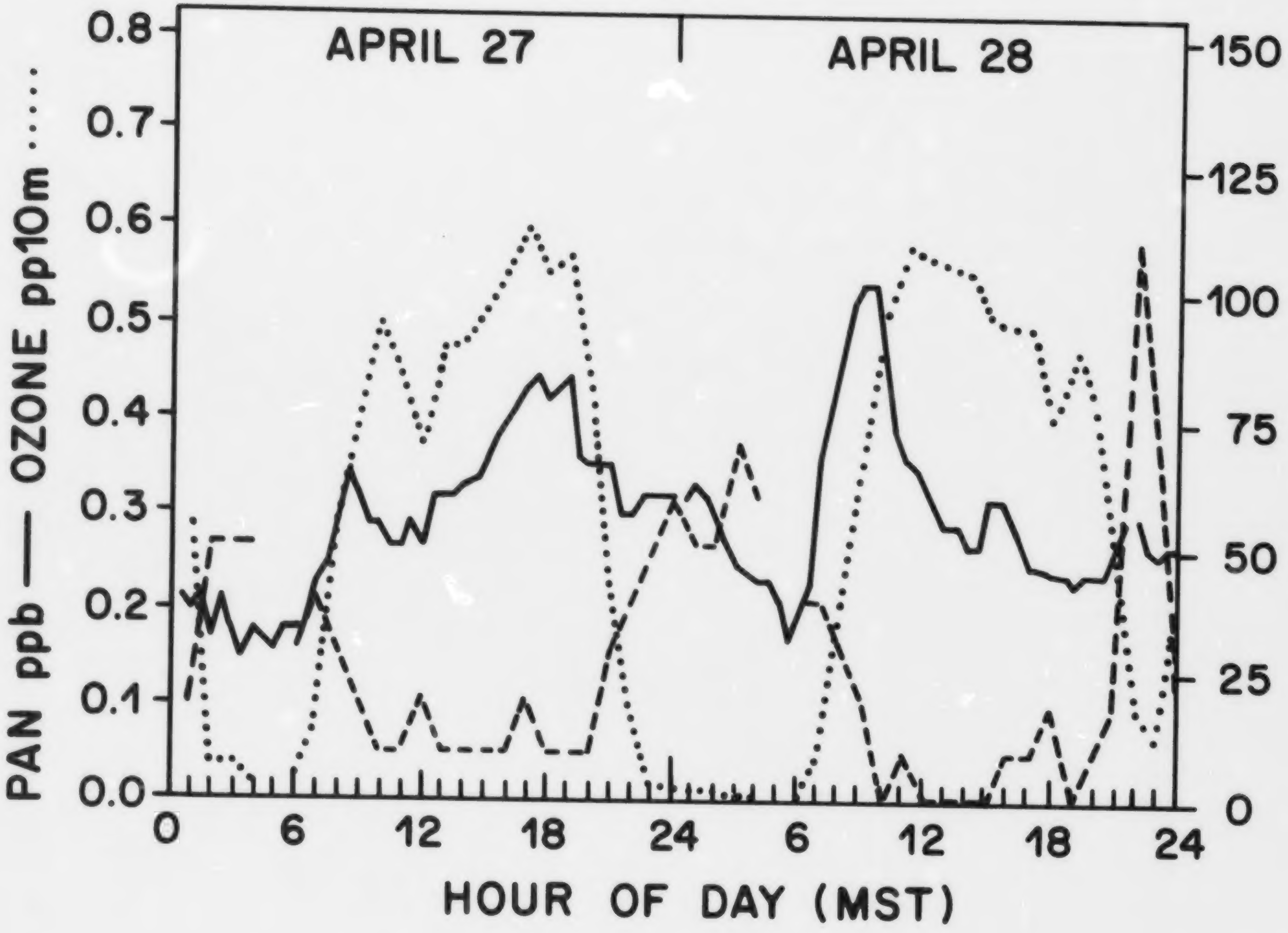


Figure 76. PAN, ozone, and NO$_x$ concentrations in Fort Saskatchewan, 1984 April 27 and 28. Case 8, episodes 1 and 2.

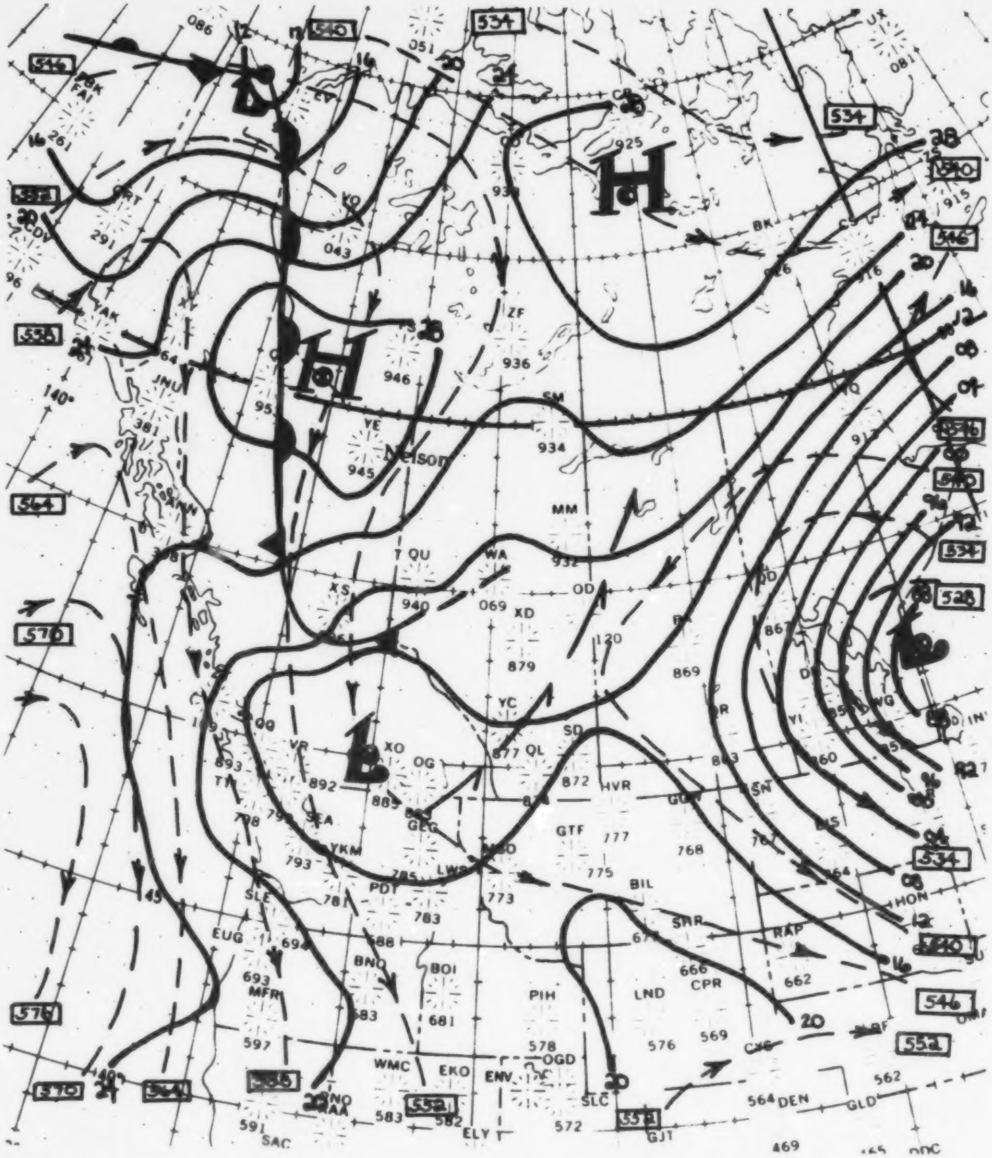

H
H
L
L
Nelson
534
540
546
552
558
564
570
576
528
20
24
28
16
12
08
04
FAI
YAK
JNU
CDV
140°
TQU
YE
SM
MM
ZF
WA
XD
OD
YC
SD
QL
XO
OG
VR
SEA
YKM
GEG
LWS
MSO
HVR
GTF
BIL
SHR
RAP
SLE
EUG
BNO
BOI
MFR
PDT
PIH
LND
CPR
WMC
EKO
ENV
OGD
SLC
GJT
DEN
GLD
ELY
SAC
RNO
HON
BIS
DDC

Figure 77. Composite surface and 500 mb analysis for 1984 April 28 at 0500 MST. Case 8. Thin solid lines are sea level isobars at 4 mb intervals; dashed lines are 500 mb height contours at 60 dam intervals. High (H) and low (L) pressure centres, TROWALS, and fronts are shown for the surface analysis. Arrows on 500 mb contours indicate the direction of the geostrophic wind at that level.

maximum of 40 ppb at 1500 MST. Nitrogen oxides decreased as ozone increased, and the PAN maxima coincided with elevated ozone concentrations.

In Fort Saskatchewan, ozone rose from an overnight low of 2 ppb at 0600 MST to 60 ppb at 1700 MST, declining from 43 ppb at 2000 MST to 1 ppb at 2400 MST. Nitrogen oxides were low during the times of peak ozone concentration, ranging from 10 to 20 ppb.

The influence of the surface ridge and the airflow changes near Edmonton as the TROWAL traversed the area are illustrated in Figure 78. Surface winds across Edmonton shifted from light northwesterly ahead of the ridge to southeasterly behind it. Mostly scattered clouds (0.6 coverage) were reported throughout the day, except for increasing amounts of thin cirrus after 27/1600 MST. Visibility generally remained good throughout the period. The maximum temperature was 9^{o}C. An urban heat island effect was noted at 27/0400 to 0500 MST and at 21/2100 MST (maximum YED-YEG temperature difference was 5C^{o}).

Stability estimates based on the Stony Plain radiosonde and the Edmonton temperatures suggest that mixing depths increased very rapidly to a maximum of about 2400 m after 27/0800 MST, when the nocturnal inversion was destroyed. With the evening cooling, it appears that the nocturnal inversion was reestablished about 27/1900 MST, with mixing depths decreasing rapidly to less than 300 m after that time.

Trajectories ending at EDMU and at Fort Saskatchewan near the time of the PAN extreme are presented in Figure 79. The trajectories show the influence of the changing synoptic conditions. Air parcels generally moved from the north, stagnated to the southeast of EDMU and Fort Saskatchewan, and finally reached the PAN monitors from the latter direction. These paths suggest that the large difference between the EDMU and Fort Saskatchewan extreme concentrations (2.29 versus 0.44 ppb) was due to the path of the air. The EDMU trajectory passed over the city of Edmonton and remained in the vicinity for many hours before reaching EDMU. The Fort Saskatchewan trajectory had a much cleaner history. The correlation of the times of the maxima is possibly related to the simultaneous change in regional-scale static stability (the change in the mixing depth restriction after 27/1900 MST). The morning PAN maxima may also be tied to a regional-scale

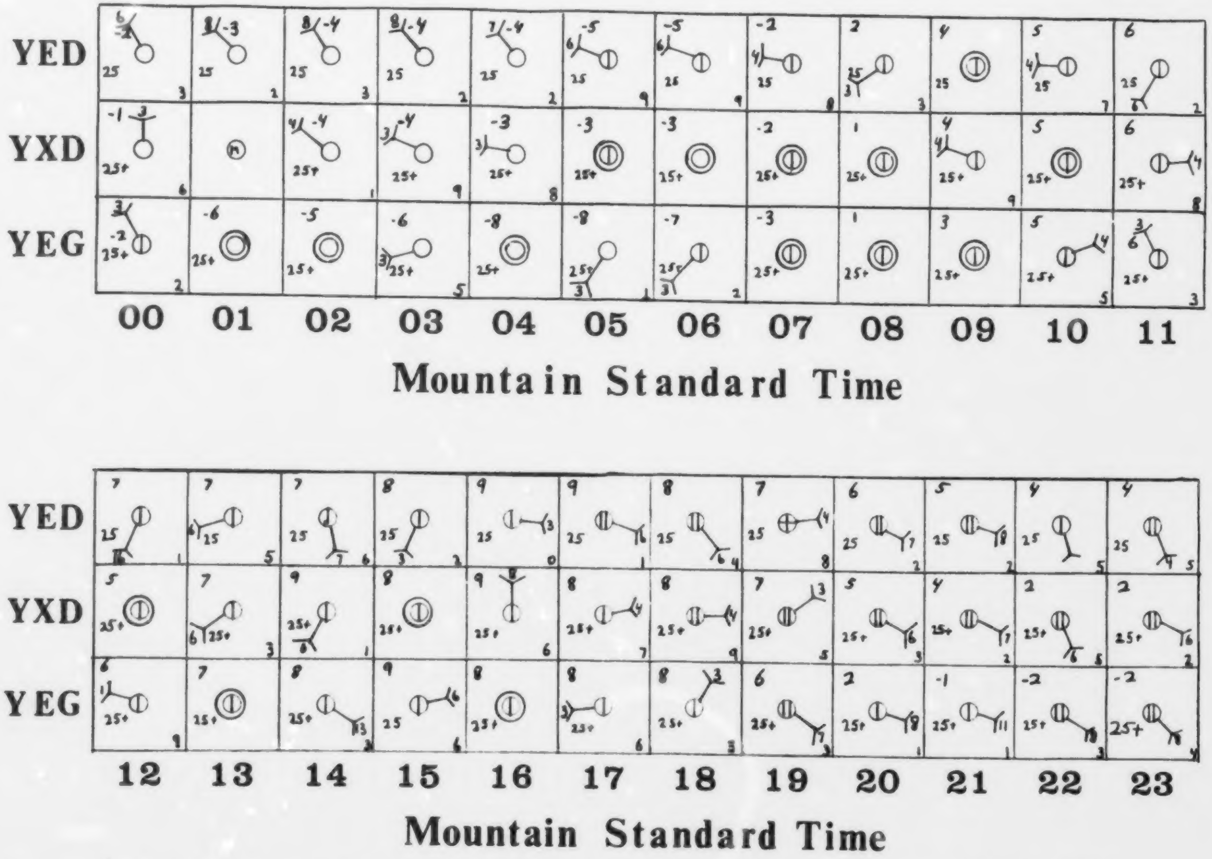


Figure 78. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1984 April 27. Case 8, Episode 1. Explanation of symbols appears in Table 2.

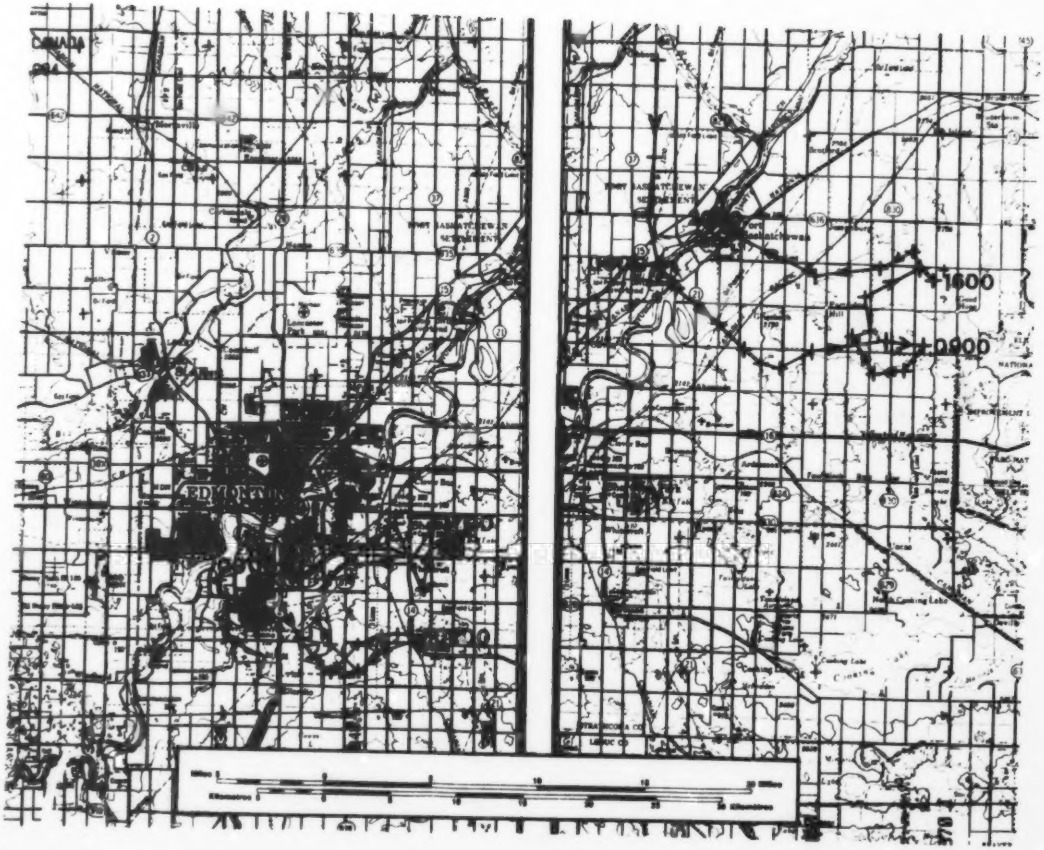


Figure 79. Air parcel trajectories at 2000 MST, 1984 April 27. Case 8, Episode 1. LEFT: Trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU). RIGHT: Trajectory terminating at Fort Saskatchewan. Hourly positions along the trajectories are indicated by crosses, and the trajectory directions by arrowheads.

change in stability, i.e., a fumigation event as the nocturnal inversion broke down simultaneously over the entire area. A trajectory ending at EDMU at the time of the secondary PAN maximum (1.12 ppb at 27/1430 MST, not shown) was quite similar to the trajectory shown in Figure 79, i.e., it also traversed the Edmonton urban region twice.

4.6.1.8.2 Case 8, Episode 2, 1984 April 28. The PAN records for Case 8 (figures 75 and 76) show similarity in shape to several previous cases/episodes, i.e., there is a sharp increase in the morning followed by a slower fall-off in concentrations. The peak half-hour averages reached at EDMU and Fort Saskatchewan are 1.00 ppb (28/0830 MST) and 0.54 ppb (28/0900 MST), respectively. Secondary peaks occurred at 27/1500 MST and 27/2130 MST at both stations.

Ozone concentrations in Edmonton rose rapidly from less than 0.5 ppb at 0600 MST to 47 ppb at 1100 MST. They began declining at 1800 MST from 34 ppb to 2 ppb by 2400 MST. PAN concentrations rose with ozone but reached a maximum and declined before the ozone peak was reached. Nitrogen oxides declined from 140 ppb at 0700 MST to 40 ppb at 1100 MST, corresponding to the rise in ozone. Nitrogen oxides increased from 60 ppb at 2000 MST to 110 ppb at 2400 MST, corresponding to the decline in ozone.

At Fort Saskatchewan, ozone concentrations rose from an overnight low of 1 ppb at 0600 MST to a maximum of 58 ppb at 1100 MST. Concentrations slowly declined to 42 ppb by 2000 MST and to 7 ppb by 2300 MST. Nitrogen oxides ranged from less than 5 ppb to 20 ppb during daylight hours.

Surface and 500 mb weather patterns (Figure 77) on April 28 were dominated by the approach and passage of the TROWAL and very cold temperatures aloft (-34°C at Edmonton at 500 mb for both the 28/0500 MST and 28/1700 MST soundings). The Edmonton airport observations (Figure 80) showed a continuation of high clouds and a veering of the surface winds to southerly early in the day. Later in the morning, the winds turned to northerly. Convective activity developed after noon, leading to showers by 28/1800 MST. A strong heat island formed by 28/0500 MST and again near midnight the following evening (YED-YEG

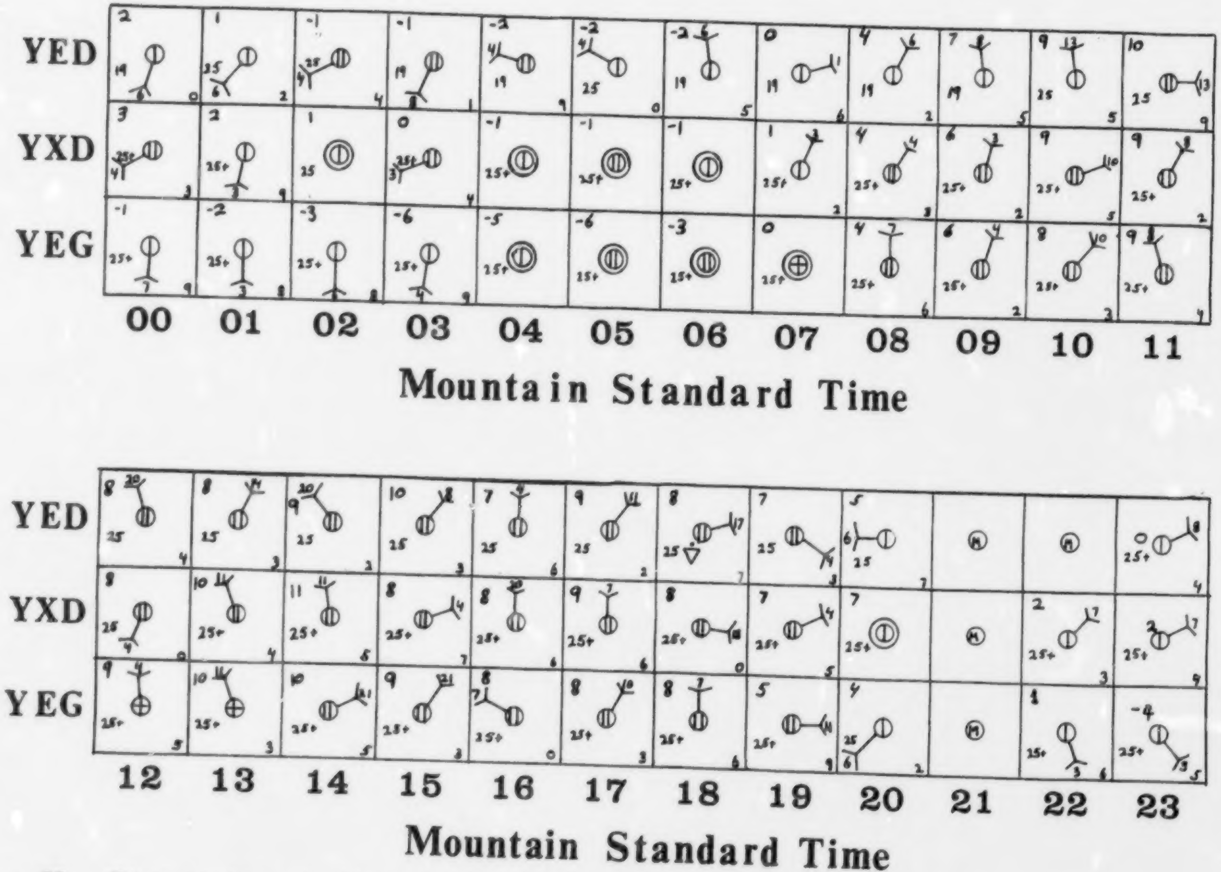


Figure 80. Time series at abbreviated surface airways (SA) reports at Namao (YED), Edmonton Industrial (YXD), and Edmonton International (YEG) airports for 1984 April 23. Case 8, Episode 2. Explanation of symbols appears in Table 2.

temperature difference was $6C^{o}$). The Stony Plain sounding and Edmonton surface temperatures suggested that the nocturnal inversion broke down between 28/0800 MST and 28/0900 MST.

Trajectories ending at EDMU and Fort Saskatchewan near the time of the PAN maxima are shown in Figure 81. It should be noted that both trajectories passed close to their terminal points some 12 hours previously. This is an important occurrence, especially for EDMU, because that monitor showed elevated PAN values above 1.00 ppb (Figure 69) just prior to 27/2100 MST. This result suggests that the 28/0900 MST PAN maximum at EDMU (and possibly at Fort Saskatchewan) was due to the recirculation of PAN produced on the previous day back into the city and then its injection into the surface in a fumigation event as the nocturnal (surface) inversion dissipated.

4.6.2 Summary of Meteorological-PAN Relationships

The meteorological conditions for eight cases (20 daily episodes) when PAN concentrations in Edmonton exceeded 0.5 ppb have been documented. Large-scale surface and upper patterns, hourly weather reports for airports near Edmonton, available soundings from Stony Plain, and boundary layer trajectories were included in the analysis.

Half-hourly measurements of PAN concentrations from the eight cases (four spring, four summer) revealed three common episode signatures: (i) a broad, fairly symmetrical record about a primary daily peak, (ii) a sharply skewed record with rapidly rising concentrations to a large daily peak followed by a slow fall-off with one or more secondary peaks, and (iii) a record composed of one or more sharp peaks of brief duration. Type ii records were most common. Type iii records were night-time occurrences and were not usually characterized by high concentrations. Evidence of a double peak, possibly tied to morning and evening traffic, was only found in one case (2).

Episode durations ranged from a few to 24 hours. Maximum concentrations ranged from 0.86 ppb to 7.51 ppb. Eighteen of the twenty episode maxima at EDMU occurred between 0900 MST and 2100 MST; while eleven occurred between 0900 MST and 1500 MST.

The upper air meteorological patterns that characterized the PAN episodes were anticyclonic without exception. Details varied greatly from case to case, from the passage of a rapidly moving, very

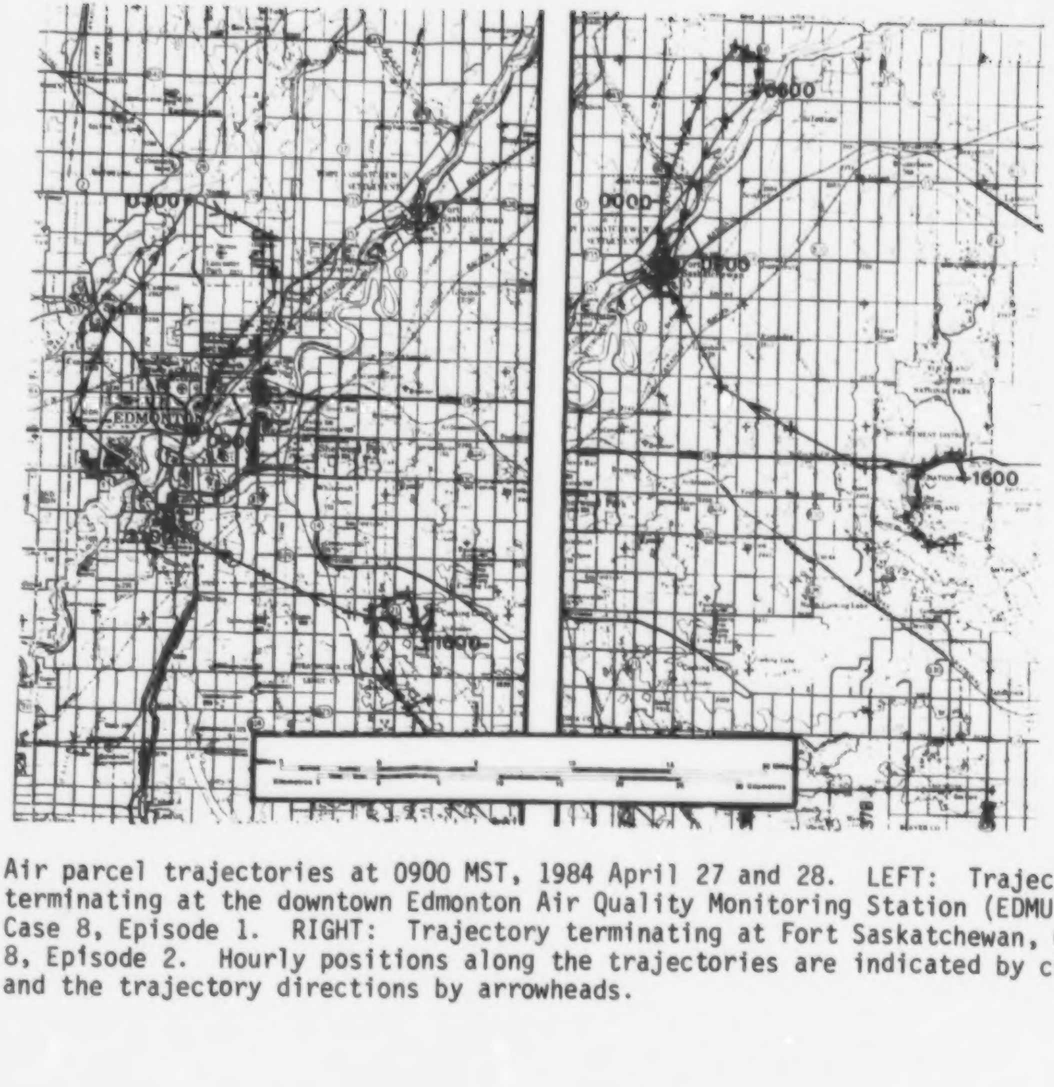


Figure 81. Air parcel trajectories at 0900 MST, 1984 April 27 and 28. LEFT: Trajectory terminating at the downtown Edmonton Air Quality Monitoring Station (EDMU), Case 8, Episode 1. RIGHT: Trajectory terminating at Fort Saskatchewan, Case 8, Episode 2. Hourly positions along the trajectories are indicated by crosses, and the trajectory directions by arrowheads.

subtle short wave ridge to a slow moving, clearly defined ridge line. Such anticyclonic flow conditions are conducive to sinking motion and the stabilization of the troposphere. These conditions favour the increase of primary pollutant concentrations and the formation of secondary pollutants by decreasing middle and high cloudiness and promoting lower mixing depths and low ventilation near the surface. Apart from a subtle response to the anticyclonic disturbances aloft, surface weather patterns during the episodes were typical of the warmer part of the year. Weak pressure gradients and ill-defined air mass boundaries were common. Despite these conditions, careful analysis of the pressure and wind field often revealed coherent, transient synoptic structures to which the general large-scale windfield (and thus, the trajectories) clearly responded. Two cases (1 and 2) were significantly influenced by the presence of weak frontal zones in the Edmonton area. These slow moving transition zones contributed to very stagnant wind conditions and shallow mixed layers (see Mathews et al. 1983).

In nearly all cases, the city of Edmonton developed a heat island in the late evening and early morning hours. Trajectories in a few cases (e.g., Case 2 and Case 6, Episode 1) suggested that a weak surface inflow was induced by the city at the time of the maximum heat island development in agreement with the findings of Hage (1972) and Paterson (1978). Similarly, a weak afternoon valley flow (northeasterly) in the North Saskatchewan River Valley was suggested on at least one occasion (see Case 2 for an example), although the wind network was often too crude to resolve such small-scale circulations.

Twelve-hour trajectories did not indicate a consistent long distance "source" for the air that reached Edmonton at the time of the PAN episodes. However, the last few hourly positions of most trajectories were often east or northeast of the city, i.e., in areas with known pollution sources. In two cases (Case 6, Episode 4 and Case 8, episodes 1 and 2), the trajectories indicated that air which originated over Edmonton returned to the city at the time of the PAN maximum, some 12 to 14 hours later.

The trajectories constructed in the present study should only be taken as rough indicators of the actual air movements. Data were biased toward the Strathcona network, and represented surface conditions only. Certainly during well-mixed, well-ventilated conditions, surface winds were good approximations of boundary layer winds, but there were several occasions when this was not true. For example, the surface windfield was uncoupled from the general flow aloft during very stable conditions. The horizontal transport just above the surface may not be well represented by surface trajectories in those cases.

No clear relationship was apparent between sky cover or solar radiation (from Ellerslie) and PAN occurrence, although the highest PAN concentrations occurred on the days with the least sky cover. Similarly, the relation between PAN and mixing depth was not clear. PAN occurred both with quite stagnant conditions (i.e., restricted visibility and mixing depths) and with very good visibility and deep mixed layers.

4.6.3 Meteorological Contributions to PAN Events

Some understanding of the complicated relations between PAN and the meteorological conditions can be found if the behaviour of PAN at EDMU can be described by a simple budget, i.e.: If, as a first approximation, the rate of change of PAN ($\delta x/\delta t$) is assumed to be governed only by the chemical processes of production (P) and destruction (D) and by the meteorological processes of horizontal transport (TR) and diffusion due to turbulence (TD), then

$$\frac{\delta x}{\delta t} = P + D + TR + TD \qquad (1)$$

4.6.3.1 Production. Since PAN is generated by photochemical reactions, there should be a bias in PAN occurrence due to in situ production (P) toward daylight hours, as is indicated in the present study. Because PAN is also dependent upon NO_x, then in situ production should result in greater concentrations over an urban area, which has many potential sources of NO_x, primarily automobiles. The present study roughly supports this contention, i.e., PAN concentrations at EDMU were significantly higher than those measured simultaneously at Ellerslie.

Because automobiles are such an important source of NO_x, two peaks in PAN concentration might be expected, one corresponding with the morning traffic, and one with the later afternoon. However, this characteristic was not commonly observed during the Edmonton PAN episodes examined. A second possible reason for the lack of a peak is that NO_x and/or PAN sources other than the city are masking the background variation due to traffic. In that case, meteorological processes (TR and TD) must contribute significantly.

4.6.3.2 Destruction. If it can be assumed that PAN destruction (D) is primarily a surface absorption phenomenon, then PAN measured near the surface (e.g., at EDMU) must be constantly replaced via production or one of the meteorological processes if it is to increase or persist. Since conditions of light winds (little transport) and strong boundary layer stability (little turbulent diffusion) are common at night when production is zero, PAN concentrations in the boundary layer should be low at that time, as was generally the case in the current investigation. On those few occasions when PAN maxima occurred at night, clearly, TR and TD were the only possible sources of PAN.

4.6.3.3 Horizontal transport. The contribution of TR to PAN occurrence in Edmonton is difficult to evaluate because the horizontal gradients of PAN (or NO_x) are not measured precisely. If the spatial distribution of PAN is circularly symmetrical with respect to a maximum at EDMU, then a wind from any direction will decrease the PAN concentration at that point, i.e., clean air will be brought into the city. This does not seem to be the case. In fact, the trajectories for most of the maxima that were observed in the present study suggest that sources of PAN for EDMU lay a few tens of kilometers to the east (SE-NE).

4.6.3.4 Turbulent diffusion. If it can be assumed that TD acts primarily in the vertical to bring about significant changes in PAN concentrations, then there are two primary processes to be considered. The first is daytime convective mixing and the second is mechanical mixing due to turbulent eddies produced by strong vertical wind shears.

The first process is proportional to the height of the mixed layer and leads to several scenarios: (1) if PAN is produced homgeneously throughout the mixed layer, then surface destruction will be offset to some extent by the downward mixing of PAN; (2) if PAN is only produced in the lower portion of the mixed layer, its concentration will be decreased both by upward mixing and surface destruction; (3) if PAN is not present in the mixed layer, but it exists in an elevated stable layer, a diurnally growing mixed layer will be "fumigated" with PAN when it intersects the elevated PAN layer. A sharp increase in PAN will be experienced in this case, followed by a marked decrease as the PAN in the elevated layer is rapidly exhausted. The second process, mechanical mixing, can have the same effects as convective mixing, day or night.

The scenario that seems to offer the most promise is the following: Production of PAN with upward mixing during the day is followed by decoupling of the upper and lower parts of the boundary layer at night due to surface cooling and increased static stability. The latter process leads to the insulation of an elevated layer of PAN from destructive processes near the ground. Mechanical or thermal turbulence can then bring the PAN to the surface suddenly in a fumigation event. The role of the local meteorology is to transport pollutants from available sources, wherever they are, and bring it to, or keep it near, Edmonton until turbulence occurs. Mechanisms available include convection, valley circulation, heat island circulation, and a variety of synoptic circulations.

The present study provided several instances where fumigation apparently occurred in mid-morning due to the growth of the mixed layer or at night due to mechanical mixing (e.g., cases 2, 3, 5, 6, 7, and 8). These situations are characterized by Type ii (skewed) and Type iii (spiked) PAN records discussed earlier.

4.7 PARTICULATE NITRATE AND NITRIC ACID

4.7.1 Atmospheric Concentrations

Particulate nitrate and nitric acid measurements were made using the dual filter pack method (Anlauf et al. 1985). In this report, the convention of Grosjean (1983) was adopted, in which nitrate retained by the Teflon filter is referred to as particulate nitrate (PN) and nitrate collected by the nylon filter is referred to as nitric acid. The sum of the Teflon filter-collected nitrate and the nylon filter-collected nitrate represents the total atmospheric inorganic nitrate.

During the period November 1982 to October 1983, filter samples were collected in Edmonton on 351 days. Most samples were collected on a 0000 to 2400 MST basis but, on nine days in July, sampling periods of 0000 to 0600 MST, 0600 to 1200 MST, 1200 to 1800 MST, and 1800 to 2400 MST were used. Complete analytical results are contained in Appendix 9.3 and are summarized in Table 11.

The mean total nitrate concentration for the year beginning 1982 November 01 was 1.46 $\mu g/m^3$, consisting of 1.16 $\mu g/m^3$ particulate nitrate and 0.30 $\mu g/m^3$ nitric acid. The highest total nitrate concentration, 8.30 $\mu g/m^3$, consisting of 8.08 $\mu g/m^3$ PN and 0.28 $\mu g/m^3$ nitric acid was recorded on 1982 December 20. This was also the highest PN concentration, whereas the highest nitric acid concentration was 2.36 $\mu g/m^3$, recorded on 1983 July 28.

The total nitrate concentration of 1.46 $\mu g/m^3$ is low compared with values reported for major United States cities and for Eastern Canadian cities (Barrie et al. 1981). The mean TN concentration, measured at the CN Tower in Toronto over an 11-month period from June 1979 to June 1980, was 2.94 $\mu g/m^3$, compared with 1.46 $\mu g/m^3$ in Edmonton. The mean for the months of June, July, and August 1983 in Edmonton was 1.11 $\mu g/m^3$, higher than the 0.51 $\mu g/m^3$ found in Calgary for a similar period in 1982. The lower concentrations in Calgary may be attributed to higher wind speeds in Calgary, a mean of 15.3 km · h^{-1} compared with 12.3 km · h^{-1} in Edmonton for the time periods in question. The average concentration of TN, 1.75 $\mu g/m^3$ in November of 1983, was somewhat higher than the 1.0 $\mu g/m^3$ reported by Klemm and Gray (1982) for November of 1978, whereas the highest TN value for November of 1982, 5.2 $\mu g/m^3$, was slightly lower than the 5.4 $\mu g/m^3$ found in November 1978. The earlier Edmonton study (Klemm and Gray 1982) used high volume sampling (40 cfm) on paper filters, which generally gives higher TN values than the Teflon-nylon filter pack system.

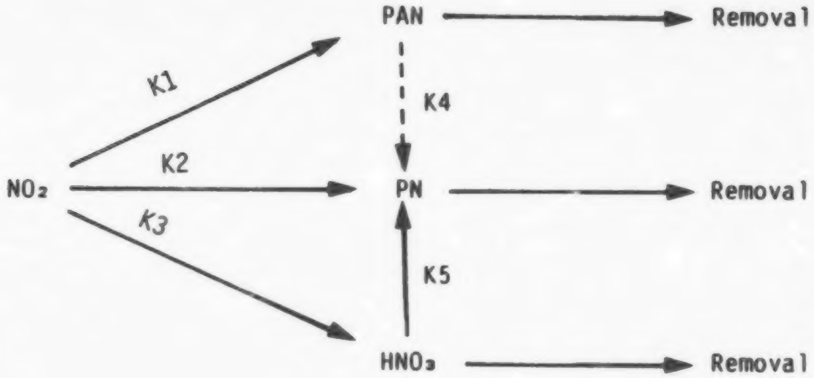
4.7.2 Nitric Acid, Particulate Nitrate, NOx, and PAN Relationships

The monthly mean concentrations of nitric acid (HNO_3), particulate nitrate (PN), nitrogen oxides (NO_x), and peroxyacetyl nitrate (PAN) are given in Table 11. The values are presented as nitrate equivalents to allow direct comparisons of concentrations among compounds of differing chemical composition. The primary pollutant NO was the most abundant of these nitrogen compounds, with a mean concentration over a 12-month period of 120 $\mu g/m^3$. Nitrogen dioxide, the initial oxidation product of NO, was also abundant with the 12-month mean concentration of NO_2 being 80 $\mu g/m^3$. The secondary pollutants PAN, HNO_3, and PN were far less abundant. PAN rather than PN or HNO_3 was the major product of photochemical conversion of NO_x in the Edmonton atmosphere. The mean PAN concentration was 4.2 $\mu g/m^3$ compared with 0.30 $\mu g/m^3$ HNO_3 and 1.22 $\mu g/m^3$ PN. The implication is that the conversion of nitrogen oxides to nitrate in the Edmonton atmosphere proceeds via the PAN intermediate rather than the HNO_3 intermediate. This is not necessarily the case, however, because the concentrations of PAN, HNO_3, and PN in the atmosphere are controlled by meteorological as well as chemical processes such as the rates of formation, transformation, and deposition. Although it is recognized that a complex series of interrelated reactions occur, simplistically the overall chemical process could be described by

Table 11. Concentrations of PAN, PN, HNO_3, and NOx in the Edmonton atmosphere (calculated as µg/m³ of NO_3, monthly means) and the fractional conversion (Fn).

Date	PAN	PN	HNO_3	NO_x	Fn
Nov 1982	2.1[a]	1.52	0.23	300	0.010
Dec 1982	1.2	1.63	0.14	360	0.008
Jan 1983	2.4	1.68	0.19	330	0.013
Feb 1983	4.0	2.28	0.23	250	0.025
Mar 1983	5.7	1.98	0.28	190	0.040
Apr 1983	4.5	0.91	0.23	140	0.034
May 1983	4.2	0.39	0.22	110	0.042
Jun 1983	6.0	0.34	0.28	110	0.057
Jul 1983	5.2	0.81	0.67	110	0.057
Aug 1983	7.6	0.71	0.50	140	0.059
Sep 1983	3.6	0.66	0.28	140	0.031
Oct 1983	3.9	1.73	0.39	220	0.027
12 months	4.2	1.22	0.30	200	0.034

[a] No data available for November 1982; value from November 1983.



The rate constant K3 for the formation of HNO_3 by the reaction

$$NO_2 + HO^{\cdot} \rightarrow HNO_3$$

is about 25 times greater than the rate constant K1 for the formation of PAN by the reaction

$$NO_2 + CH_3COO_2^{\cdot} \rightarrow CH_3COO_2NO_2$$

$K3 = 1.2 \times 10^4$ ppm · min^{-1} (Hampson and Garvin 1975) compared to
$K1 = 4.8 \times 10^2$ ppm · min^{-1} (Demerjian et al. 1974).

In order for the steady state concentration of PAN in the atmosphere to be higher than that of HNO_3, the PAN removal mechanisms must be far less efficient than the HNO_3 removal mechanisms. Measured concentrations of HNO_3 in the atmosphere are lower than predicted from models, indicating that the heterogeneous processes that remove HNO_3 are more efficient than estimated (Kelly et al. 1980). PAN is removed by homogeneous gas phase reactions and by surface reactions. The reaction rate constant for the reaction of PAN with NO, the major gas phase reaction, is 0.16 ppm · min^{-1} (Schuck and Stephens 1969). The effective removal rate by surface reactions is similar, thus PAN probably was a lifetime of days in the lower troposphere (Garland and Penkett 1976).

The concentrations of PAN, HNO_3, PN, and NO_x show clear seasonal variations (Table 11). The highest concentrations of PAN and HNO_3 occurred during the summer months, whereas the highest concentrations of PN, NO, and NO_2 occurred in the winter. Detailed NO_x data (NO and NO_2) and THC data are available from Alberta Environment. Nitric acid concentrations were highest in July, with a mean of 0.67 $\mu g/m^3$, and lowest in December, with a mean of 0.14 $\mu g/m^3$. PAN concentrations were highest in August at 7.6 $\mu g/m^3$ (as NO_3 equivalents) and lowest in December at 1.2 $\mu g/m^3$. The influence of solar radiation and temperature on PAN and HNO_3 formation is apparent. As shown in Table 12, solar radiation in Edmonton over the study period ranged from 2.22 $MJ/m^2/d$ in December of 1982 to 21.45 $MJ/m^2/d$ in July of 1983, and the mean monthly temperature ranged from a low of $-8.5^{\circ}C$ in January 1983 to a high of $19.0^{\circ}C$ in August. Winds were lowest in February at 6.6 $km \cdot h^{-1}$, and highest in June at 13.7 $km \cdot h^{-1}$ The high winds would be expected to disperse the pollutants generated within the city. This is apparently true for NO_x, with the lowest concentrations being recorded in the windiest months, May, June, and July. The increased solar radiation and temperature in the summer months are more than sufficient to overcome the negative effects of higher wind speeds, and result in relatively high HNO_3 and PAN concentrations in the summer months. The seasonal variation in PN reflects the variation in NO_x (NO plus NO_2).

The role of atmospheric chemistry as distinct from meteorology is best shown by comparing the relative amounts rather than the absolute concentrations of atmospheric pollutants. Figure 82 shows two such comparisons, the PAN/PN ratio and the HNO_3/PN ratio, based upon monthly means. Both ratios show a strong seasonal variation and a relative increase in PAN and HNO_3 during the summer compared with PN.

The PAN to HNO_3 ratio showed a seasonal variation (Figure 83). With the exception of July (July PAN data seem anomalously low as evidenced by both the PAN/PN and the PAN/HNO_3 ratios), February to August PAN/HNO_3 ratios were above 15 whereas September to January ratios fell in the 8 to 13 range. The overall PAN to HNO_3 ratio for the 12-month study period was 14.1.

Table 12. Mean monthly total daily solar radiation on horizontal surface, mean monthly temperature, and mean monthly wind speeds at Edmonton, November 1982 to December 1983.

Month	Solar Radiation (MJ/m²/d)	Temperature (°C)	Wind Speed (km/h)
Nov 1982	4.00	- 7.4	9.8
Dec 1982	2.22	- 7.7	9.0
Jan 1983	3.34	- 8.5	8.6
Feb 1983	5.70	- 6.5	6.6
Mar 1983	10.67	- 3.0	8.2
Apr 1983	16.95	6.1	11.9
May 1983	19.58	11.3	13.3
Jun 1983	19.11	15.1	13.7
Jul 1983	21.45	17.9	13.2
Aug 1983	20.37	19.0	10.1
Sep 1983	11.58	9.8	12.8
Oct 1983	7.43	6.3	9.8
Nov 1983	2.98	- 2.9	9.5
Dec 1983	2.82	-17.6	9.5

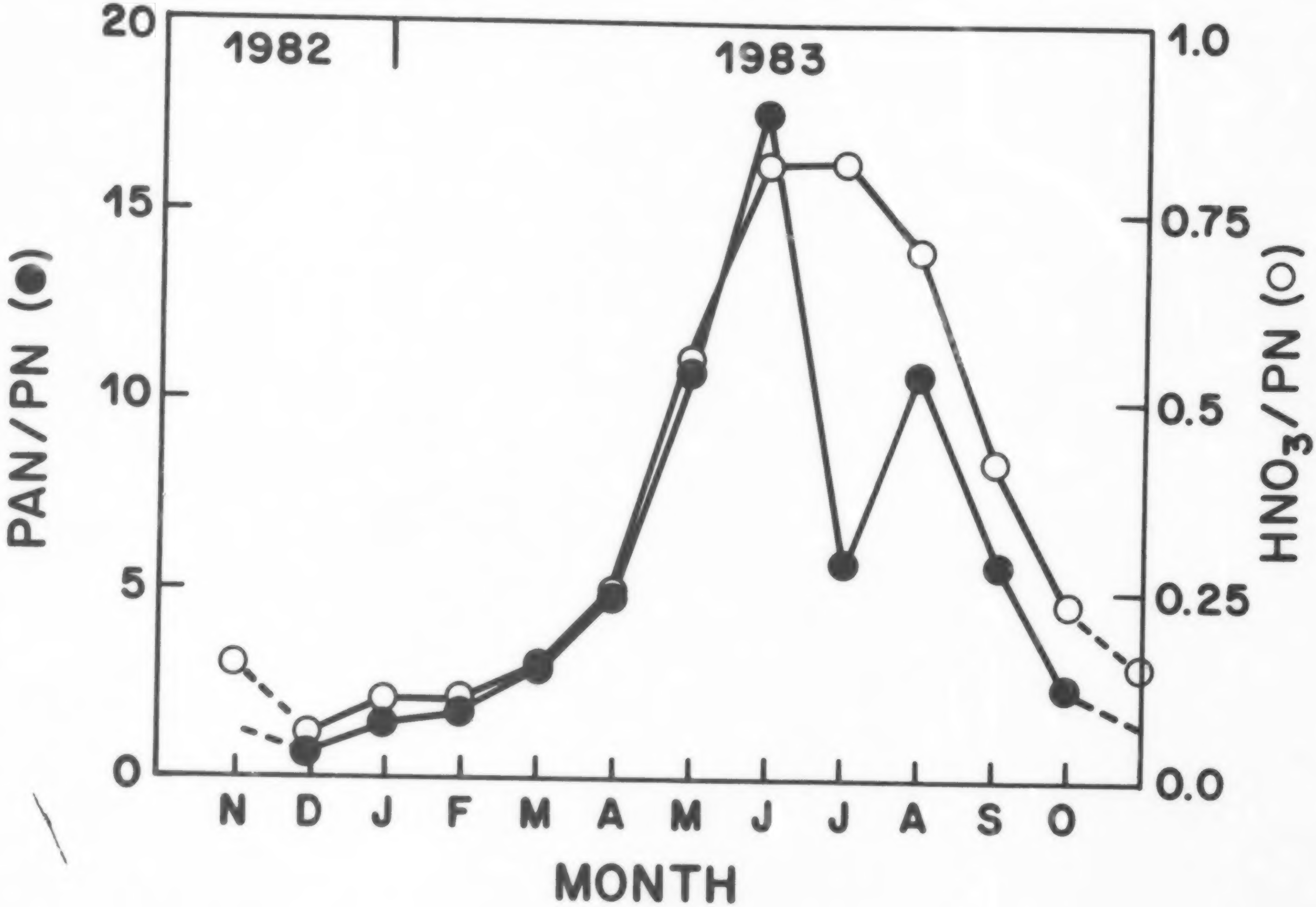


Figure 82. Seasonal changes in PAN/PN and HNO_3/PAN ratios in Edmonton, November 1982 to October 1983.

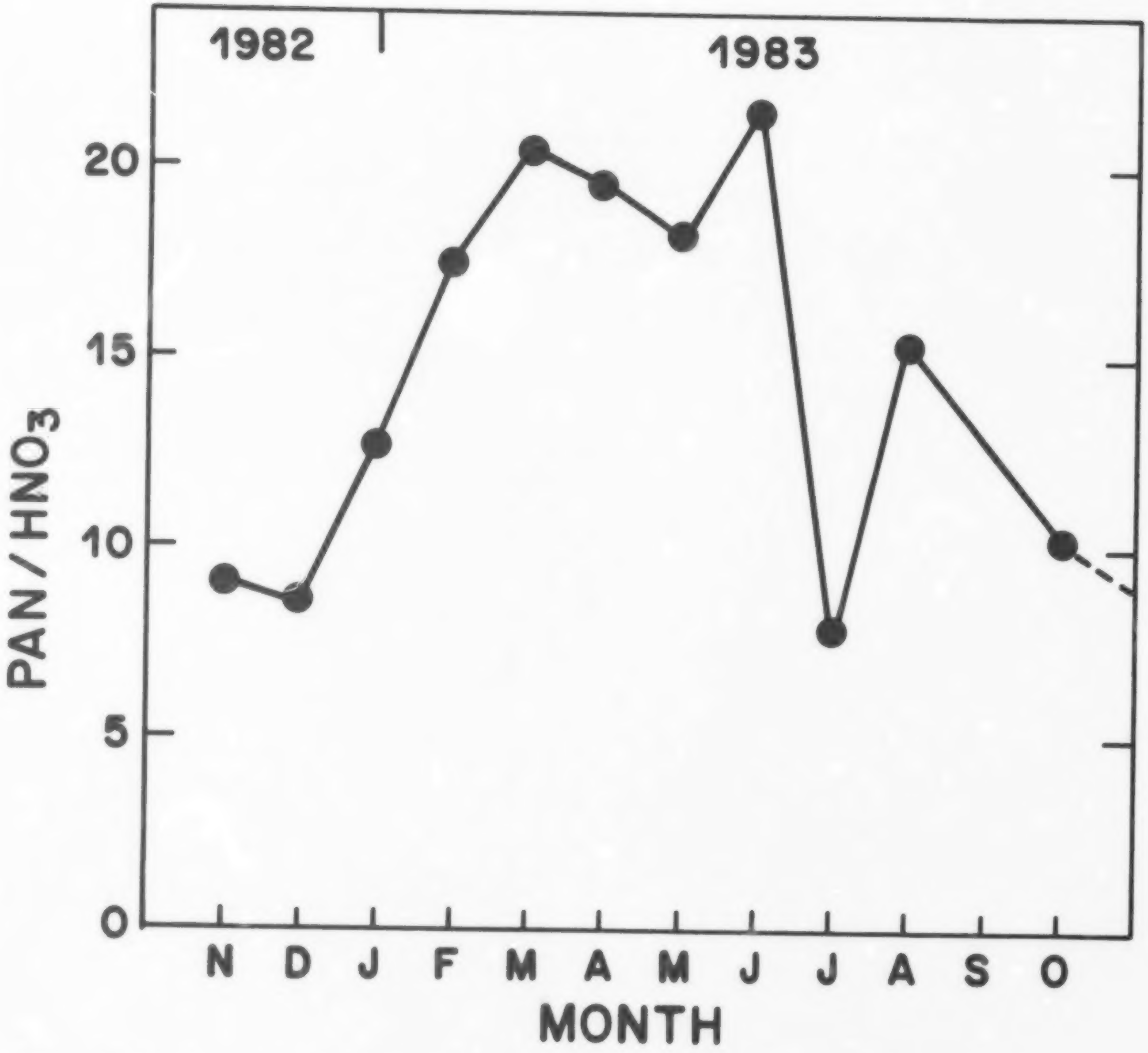


Figure 83. Seasonal changes in PAN/HNO_3 ratios in Edmonton, November 1982 to October 1983.

The amount of non-methane hydrocarbons (NMHC) greatly influences the rate of conversion of NO_x to PAN and HNO_3. In smog chamber experiments, lower levels of NMHC restricted the initial rate of PAN formation, resulting in PAN/HNO_3 ratios of less than 0.5, whereas NMHC/NO_x ratios of 15 or greater gave PAN/HNO_3 ratios of greater than 1 (Spicer et al. 1978). Over longer time periods, however, the amount of NMHC had little effect on the ultimate PAN/HNO_3 ratio. More recently, Spicer (1983) has shown the rate of conversion of NO_x to products to be linearly related to the NMHC/NO_x ratio. Ratios of less than 20 are predicted to produce PAN/HNO_3 ratios of less than 1. NMHC measurements in Edmonton are limited. From the data of Sandhu (1975), the mean concentrations during July and December of 1974 in downtown Edmonton were 150 and 640 ppb, respectively.

The PAN/HNO_3 ratios in Edmonton were calculated for 61 days, during which PAN concentrations were above the 0.15 ppb detection limit for each of the 48 half-hour readings and the HNO_3 concentrations exceeded 0.1 $\mu g/m^3$. The ratio varied greatly, from as low as 0.45 to as high as 11.3, but on most days fell between 2 and 5 (35 of 61 days). This range is higher than the 1 to 3 found by Spicer (1977) and 0.3 to 0.8 reported by Tuazon et al. (1981) for smoggy days in St. Louis and Claremount, California, respectively.

The fractional conversion (Fn) of NO_x to reaction products may be calculated as

$$Fn = \frac{HNO_3 + PAN + NO_3}{NO + NO_2 + HNO_3 + PAN + NO_3}$$

The Fn value for the 12-month period based upon all data collected was 0.034, indicating a very low conversion rate of NO_x to secondary pollutants on a yearly basis. The summer (June, July, and August) mean was 0.06. This compares with values of 0.11 downwind of Los Angeles (Spicer 1982). In Calgary, the mean Fn value for 14 days in July and August of 1982 was also low, 0.08 (Peake et al. 1985). In the case of

Calgary, measurements were made only 6 km downwind of the city centre. In Edmonton, measurements were made downtown, thus the time available for conversion of NO_x to PAN, HNO_3, and PN in both cases would generally be short, accounting for the low conversion factors. The Fn values also showed seasonal variations (Figure 84). As would be expected, the lowest conversion rates occurred in the winter months (0.008 in December 1982) and the highest in summer (0.059 in August). These seasonal variations reflect both the increase in PAN and HNO_3 in the summer months and the increase in NO_x in the winter months.

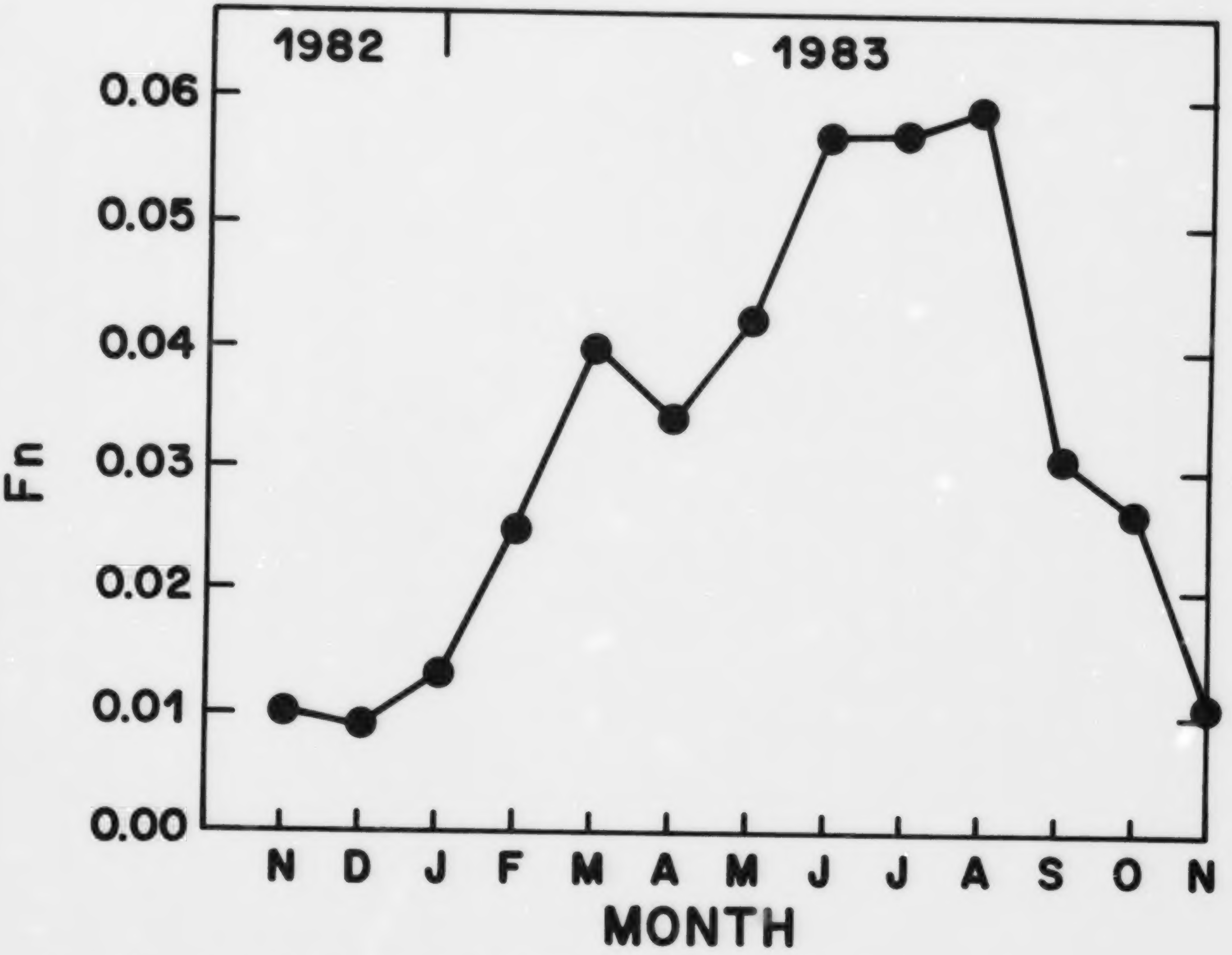


Figure 84. Seasonal changes in fractional conversion (Fn) of NO_x to reactive products in Edmonton, November 1982 to October 1983.

5. BIOLOGICAL EFFECTS

Peroxyacetyl nitrate is the most phytotoxic of the known photochemical oxidants (National Research Council 1977). It reacts with the sulphydryl groups in enzymes, inhibiting cyclic photosyntheic phosphorylation (Dugger and Ting 1970; Mudd 1963, 1966; Mudd et al. 1966). Compounds such as coenzyme A, lipoic acid, and cystein are oxidized, whereas alcohols and amines are acetylated (Nicksic et al. 1967; Wendschuh et al. 1973). Illumination is required before any symptoms of damage are observed, with maximum effect at wavelengths of 420 to 480 nm indicating that carotenoid and flavin pigments in the leaf cells are affected (Dugger et al. 1963).

Concentrations of PAN of 15 to 20 ppb with an exposure time of four hours causes injury to sensitive species such as pinto beans and oats (Linzon et al. 1975; Taylor 1969). Within two to three hours after exposure of susceptible species to PAN, the lower leaf surface develops an oily or waxy appearance, which changes to a bronzed area in two or three days (Taylor and MacLean 1970). These symptoms are caused by collapse of the protoplast of the mesophyll cells in the region of the stomata, giving rise to air pockets and drying out of the epidermis. The above symptoms are the result of light-to-moderate exposure and are visible only on the lower leaf surface (Taylor et al. 1974). By contrast, ozone produces chlorotic mottling or flecking on the upper surface (Heggestad 1971; Hill et al. 1972; Linzon et al. 1975).

Acute PAN injury seldom develops in the leaves of woody shrubs and trees, but succulent ornamentals, grasses, and vegetables are severely injured (Taylor 1973). The injury to monocotyledons appears as a distinct transverse leaf band (Taylor and MacLean 1970; Heggestad 1971). Concentrations of PAN in Alberta at present are too low to produce such an injury. A more complete review of the effects of PAN on plants is to be found in a previous report to Alberta Environment, The Oxides of Nitrogen and Their Interactions in the Environment: A Review (Legge et al. 1980).

Peroxyacetyl nitrate is a strong eye irritant (Mudd 1975; Stephens et al. 1960) and has been suggested as a possible cause of skin cancer (Lovelock 1977). Symptoms of eye irritation appear at concentrations of 150 to 200 ppb. PAN occurs with other peroxyacyl nitrates such as peroxypropionyl nitrate and peroxybenzyl nitrate which are biologically more active. Peroxybenzyl nitrate is 200 times more active as an eye irritant than formaldehyde (National Research Council 1977). Exposure of healthy persons to 300 ppb PAN leads not only to eye irritation,but also causes an increase in oxygen uptake, especially during exercise (Ferris 1978).

The low concentrations of PAN and its analogues presently found in the Edmonton atmosphere are not likely to present a health hazard, except possibly to highly allergic individuals.

6. SUMMARY AND CONCLUSIONS

1. Peroxyacetyl nitrate (PAN) was sampled every 30 minutes from 1982 December 21 to 1984 May 14 at a downtown Edmonton location (EDMU), from 1983 August 17 to September 16 and 1984 April 17 to May 15 at Fort Saskatchewan, and from 1983 July 13 to August 11 in Ellerslie.

2. The highest concentrations of PAN recorded were 7.51 ppb at Edmonton on 1983 August 23, 0.75 ppb at Fort Saskatchewan on 1984 April 21, and 1.30 ppb at Ellerslie on 1983 August 03. The mean concentration of PAN in Edmonton was 0.24 ppb. These concentrations are similar to those found in Calgary and are in the same range as most North American and European cities. They are far lower than concentrations in the Los Angeles Basin, where PAN concentrations of up to 65 ppb have been reported.

3. Concentrations of PAN in Edmonton usually increased rapidly in response to early morning emissions of primary pollutants and increasing intensity of solar radiation. Maximum PAN and ozone concentrations were most often reached in the early afternoon, but there were many exceptions, with maxima occurring as early as 0900 MST and as late as 2000 MST. PAN and ozone declined as NO_x increased. PAN often persisted overnight and, on occasion, a night-time maximum in PAN occurred. The mean daily maximum in Edmonton was 0.57 ppb.

4. As was the case in Calgary, PAN concentrations in Edmonton showed seasonal variations. Concentrations were highest during the late summer. Concentrations of PAN in Edmonton were limited in wintertime by the low intensity and short duration of solar radiation, and in summer by the relatively low concentration of pollutants in the atmosphere.

5. PAN episodes were highly correlated with the presence of anticyclonic synoptic disturbances (ridges) in the upper air flow. Surface synoptic conditions varied, but weak pressure gradients were common to all episodes. PAN occurred with both deep and shallow mixing depths.

6. The qualitative analysis of a simplified PAN concentration budget suggests that an important PAN source may lie just outside the city, possibly to the east and/or south.

7. PAN budget analysis suggests that asymmetries in daytime PAN records and spikes in the night-time records may be caused by the turbulent injection of PAN from an elevated layer into the surface layer.

8. During PAN episodes, synoptic disturbances both at the surface and aloft were only weakly defined, but careful analysis revealed temporally consistent and spatially coherent structures, clearly associated with mixing depth and ventilation conditions.

9. During some episodes the urban heat island, which commonly developed over Edmonton, induced a weak circulation that influenced air trajectories passing close to the city. Some evidence of weakness in the wind fields suggests a valley circulation associated with the North Saskatchewan River.

10. Ozone to PAN ratios as low as 6:1 were recorded in Edmonton on days with high PAN concentrations, but ratios were commonly in the 10 to 50 range. These ratios are similar to those found in Calgary and in Los Angeles during photochemical smog episodes. Ozone to PAN ratios at both Ellerslie and Fort Saskatchewan (generally downwind of Edmonton) were high, 80:1 to 120:1 at Ellerslie, and 70:1 to 250:1 at Fort Saskatchewan, reflecting the depression of ozone by nitrogen oxide

emissions in Edmonton and the generation of ozone downwind of the city.

11. Particulate nitrate (PN) and nitric acid (HNO_3) were sampled daily for a one-year period in Edmonton. The mean particulate nitrate concentration was 1.16 $\mu g/m^3$ and the mean nitric acid concentration was 0.30 $\mu g/m^3$. The highest PAN concentration was 8.1 $\mu g/m^3$ and the highest HNO_3 value was 2.4 $\mu g/m^3$. These concentrations are similar to those found in Calgary, and are low compared with PN concentrations found in major North American cities.

12. Particulate nitrate, nitric acid, PAN, and nitrogen oxides all show strong seasonal variations. Nitric acid and PAN are most abundant during the summer, when temperatures are highest and solar radiation most intense and of longer duration. Particulate nitrate and nitrogen oxides were most abundant in the winter months. PAN to PN ratios ranged from 0.74 to 17.7, HNO_3 to PN ratios ranged from 0.06 to 0.83, and PAN to HNO_3 ratios from 7.8 to 20.4. The fractional conversion of NO_x to reaction products was very low, ranging from 0.008 in December (0.8% conversion) to 0.059 in August (5.9% conversion).

13. PAN/nitric acid/particulate nitrate ratios indicate that PAN is the major reaction product of nitrogen oxides in the atmosphere. The decomposition of PAN may initiate the generation of nitric acid; thus, PAN may be an important agent in the long-range transport of acidic pollutants.

14. Present concentrations of PAN, PN, and HNO_3 in Edmonton are well below those previously reported to injure plants or present health problems except, possibly, to some highly susceptible individuals.

7. RECOMMENDATIONS

1. In view of the high concentrations of oxides of nitrogen found in the atmospheres of both Edmonton and Calgary, it is recommended that further research into the chemistry and environmental effects of these pollutants be undertaken.

2. In view of the role of hydrocarbons (HC) in the formation and control of photochemical air pollution, it is recommended that HC in the atmosphere of Edmonton and Calgary be characterized and quantified, that NMHC be monitored, and that the sources of NO_x, SO_x, and HC in both cities be further quantified.

3. In view of the suspected role of PAN in the long-range transport of acid-forming pollutants, it is recommended that monitoring of PAN, nitric acid, particulate nitrate, and nitrogen oxides be continued, and that monitoring stations be established in other areas of the province.

4. In order to understand and interpret daily, monthly, and seasonal air quality observations, it is recommended that integrated studies of the physics, chemistry, and meteorology of air pollution be undertaken.

5. It is recommended that existing data be used to test mathematical models of the atmospheric chemistry of air pollutants and of air pollution transport. It is further recommended that future measurements of atmospheric pollutants be made specifically to test existing mathematical models.

6. It is recommended that the effect of local circulations (i.e., urban circulation and valley circulation) upon pollutant concentrations be further studied and that a

more dense wind network and pollution monitoring network be established.

7. It is recommended that short-term studies be initiated to define the vertical PAN, HNO_3, and particulate nitrate gradients and the extent of elevated PAN layers. A properly instrumented aircraft should be used for these studies.

8. It is recommended that continuous measurements of mixing height be made to SODAR at least at EDMU and at Ellerslie to promote information on the diurnal variation and horizontal gradients of the depth of the mixed layer.

8. REFERENCES

Adamson, P. and H. H. Gunthard. 1980. Reinvestigation of the matrix i.r. spectrum of peroxyacetylnitrate (PAN). Spectrochimica Acta 36A:473-475.

Alberta Environment. 1977. Air monitoring annual report: City of Calgary. Edmonton, Alberta. 29 pp.

Alberta Environment. 1977. Air monitoring annual report: City of Edmonton. Edmonton, Alberta. 29 pp.

Alberta Environment. 1978. Air monitoring annual report: City of Calgary. Edmonton, Alberta. 29 pp.

Alberta Environment. 1978. Air monitoring annual report: City of Edmonton. Edmonton, Alberta. 29 pp.

Alberta Environment. 1979. Air monitoring annual report: City of Calgary. Edmonton, Alberta. 29 pp.

Alberta Environment. 1979. Air monitoring annual report: City of Edmonton. Edmonton, Alberta. 29 pp.

Alberta Environment. 1980. Air monitoring annual report: City of Calgary. Edmonton, Alberta. 29 pp.

Alberta Environment. 1980. Air monitoring annual report: City of Edmonton. Edmonton, Alberta. 29 pp.

Angle, R.P., H.S. Sandhu, and W.J. Schnitzler. 1979. Observed and predicted values of NO_2/NO_x in the exhaust plume from a compressor installation. Journal of the Air Pollution Control Association 29:253.

Anlauf, K.G., P. Fellin, and H.A. Wiebe. 1985. A comparison of three methods for measurement of atmospheric nitric acid and aerosol nitrate and ammonium. Atmospheric Environment 19(2):325-334.

Appel, B.R. and Y. Tokiwa. 1981. Atmospheric particulate nitrate sampling errors due to reactions with particulate and gaseous strong acids. Atmospheric Environment 15:1087-1089.

Appel, B.R., S.M. Wall, Y. Tokiwa, and M. Haik. 1980. Simultaneous nitric acid, particulate nitrate and acidity measurements in ambient air. Atmospheric Environment 14:549-554.

Appel, B.R., Y. Tokiwa, and M. Haik. 1981. Sampling of nitrates in ambient air. Atmospheric Environment 15:283-289.

Barrie, L.A., H.A. Wiebe, P. Fellin, and K. Anlauf. 1981. Results of the Canadian air and precipitation monitoring network APN: July 1979 to June 1980. Internal report, Air Quality and Inter-Environmental Research Branch, Atmospheric Environment Service. Downsview, Ontario. 65 pp.

Bos, R., R. Guicherit, and A. Hoogeveen. 1977. Distribution of some hydrocarbons in ambient air near Delft and the influence on the formation of secondary air pollutants. Science of the Total Environment 7: 159.

Bottenheim, J.W. and O.P. Strausz. 1979. The effect of polluting source on the air quality downwind of pristine northern areas. Atmospheric Enviroment 13:1085-1089.

Bottenheim, J.W. and O.P. Strausz. 1980. Gas-phase chemistry of clean air at 55°N. Environ. Sci. Technol. 14:709.

Bottenheim, J.W., S.E. Braslavsky, and O.P. Strausz. 1977. Modeling study of seasonal effect on air pollution at 60°N latitude. Environmental Science and Technology 11:801-808.

Brasser, L.J., R. Guickerit, and C. Huygen. 1977. The occurrence of photochemical smog in West Europe. VID-Berichte 270:25-32.

Brice, K.A., S.A. Penkett, D.F. Atkins, F.J. Sandalls, D.J. Bamber, A.F. Tuck, and G. Vaughan. 1984. Atmospheric measurements of peroxyacetylnitrate (PAN) in rural, south-east England: seasonal variations in winter photochemistry and long-range transport. Atmospheric Environment 18:2691-2702.

Bruckmann, P. and P. Eynck. 1979. Analyse der bildung von photooxidantien an der Mebstelle Essen-Sud. Schrift. Landessanst Immission Lands NW 49:19-28.

Campbell, J.E. 1972. The Mesoscale Circulation Induced by the City of Edmonton, Alberta. Unpublished MSc Thesis, University of Alberta, Edmonton. 119 pp.

Carter, W.P.L., A.M. Winer, K.R. Karnall, and J.N. Pitts. 1979. Smog chamber studies of temperature effects in photochemical smog. Environmental Science and Technology 13: 1094-1100.

Coffey, P.E. and W.M. Stasiuk. 1975. Evidence of atmospheric transport of ozone into urban areas. Environmental Science and Technology 9:59-62.

Corkum, R., W. Giesbrecht, T. Bardsley, and E. Cherniak. 1982. The measurement of PAN in the atmosphere at Simcoe. Presented at the 65th Annual Conference of the Chemical Institute of Canada. 1982 May 30-June 2. Toronto, Ontario. 39 pp.

Demerjian, K.L., J.A. Kerr, and J.G. Calvert. 1974. The mechanism of photochemical smog formation. Advances in Environmental Science and Technology 4:1-262.

Dugger, W.M. and I.P. Ting. 1970. Physiological and biochemical effect of air pollution oxidants on plants. Recent Advances in Phytochemistry 3:31-58.

Dugger, W.M., O.C. Taylor, W.H. Klein, and W. Shrapshire. 1963. Action spectrum of PAN damage to bean plants. Nature 198: 75-76.

Environment Canada. 1970 to 1981. National air pollution surveillance annual summaries. Ottawa, Canada.

Fellin, P., H.A. Wiebe, and K.G. Anlauf. 1980. Design and characterization of a low volume sampling system for the simultaneous sampling of atmospheric particulates and vapour phase nitric acid. Presented at the 63rd Chemical Institute of Canada Conference. 1980 June 8-11. Ottawa, Canada. 34 pp.

Ferris, B.G. 1978. Health effects of exposure to low levels of regulated air pollutants. A critical review. Journal of the Air Pollution Control Association 28:482-497.

Forrest, J., R.L. Tanner, D. Spandau, T. D'Ottavio, and L. Newman. 1980. Determination of total inorganic nitrate utilizing collection of nitric acid and NaCl-impregnated filters. Atmospheric Environment 14:137-144.

Fukuda, H. and K. Terakado. 1974. On the damages of plants due to peroxyacyl nitrates (PAN). Tokyo Nagyo Shikenjo Sukuho, February, 1974. (Original not seen; information from Temple and Taylor 1983.)

Garland, J.A. and S.A. Penkett. 1976. Absorption of peroxyacetyl nitrate and ozone by natural surfaces. Atmospheric Environment 10:1127-1131.

Grosjean, D. 1983. Distribution of atmospheric nitrogenous pollutants at a Los Angeles area smog receptor site. Environmental Science and Technology 17:13-19.

Guicherit, R. 1976. The occurrence of photochemical oxidants and their precursors in Western Europe. Proceedings of the Symposium on the Occurrence of Photochemical Pollutants, Paper number 111. (Original not seen; information from Temple and Taylor 1983.)

Hage, K.D. 1972. Nocturnal temperatures in Edmonton, Alberta. J. Appl. Meteor. 11:123-129.

Hampson, R.F. and D. Garvin. 1975. Chemical kinetics and photochemical data for modelling atmospheric chemistry. NBS Technical Note 886, U.S. Department of Commerce/NBS, Washington, D.C. (Original not seen; information from Bottenheim et al. 1977.)

Harker, A.B., L.W. Richards, and W.E. Clark. 1977. The effect of atmospheric SO_2 photochemistry upon observed nitrate concentrations in aerosols. Atmospheric Environment 11:87-91.

Hecht, T.A., J.H. Seinfeld, and M.C. Dodge. 1974. Further development of generalized kinetic mechanism for photochemical smog. Environmental Science and Technology 8:327-339.

Heggestad, H.E. 1971. Air Pollution in plants. In: Man's Impact on Terrestrial and Oceanic Ecosystems, (eds.) W.H. Mathews, F.E. Smith and E.D. Goldberg. Cambridge, Mass.: MIT Press. 15 pp.

Hill, A.C., H.E. Heggestad, and S.N. Linzon. 1972. Ozone. In: Recognition of Air Pollution Injury to Vegetation: A Pictoral Atlas, (eds.) J.S. Jacobson and A.C. Hills. Air Pollution Control Association, Pittsburg, PA. Air Pollution Control Association. 23 pp.

Izumikawa, S., N. Ito, M. Fanazima, T. Hirono, H. Yokata, M. Soufuku, K. Asakuno, K. Nakano, and T. Oodaira. 1975. Relationship of nitrogen oxides and hydrocarbons to peroxyacetyl nitrate (PAN). Annual Reports of the Tokyo Metropolitan Research Institute for Environmental Protection, 1975:9-22.

Jorgen, R.T. 1978. Ambient peroxyacetyl nitrate (PAN) measurements in the Houston area. Final report on the Houston Area Oxidants Study. Prep. for the Houston Chamber of Commerce by Rockwell International Corporation, Atomics International Division, Air Monitoring Center, Houston. 23 pp.

Joseph, D.W. and C.W. Spicer. 1978. Chemiluminescence method for atmospheric monitoring of nitric acid and nitrogen oxides. Analytical Chemistry 50:1400-1403.

Kelly, T.J., D.H. Stedman, J.A. Ritter, and R.B. Harvey. 1980. Measurements of oxides of nitrogen and nitric acid in clean air. Journal of Geophysical Research 85:7417-7425.

Klemm, R.F. and J.M.L. Gray. 1982. A study of the chemical composition of particulate matter and aerosols over Edmonton. Prepared for the Research Management Division of Alberta Environment by the Alberta Research Council. Report RMD 82/9. 125 pp.

Kokin, A., L.G. Wayne, and M. Weisburd. 1973. Controlled evaluation of the Reactive Environmental Simulation Model (REM), Volume II: user's guide. Pacific Environmental Services, Inc., Santa Monica, California. EPA No. R4-73-013b, NTIS No. PB 220 457/6.

Legge, A.H., E.M. Van Zinderen Bakker, E. Peake, and D.C. Lindsay. 1980. The oxides of nitrogen and their interactions in the environment: a review. Canadian Petroleum Association and Alberta Environment, Edmonton. 165 pp.

Lester, P.F. 1976. The chinook of southern Alberta: a problem assessment. Presented at the 10th CMOS Cong., Quebec City.

Lewis, T.E., E. Brennan, and W.A. Lonneman. 1983. PAN concentrations in ambient air in New Jersey. Journal of the Air Pollution Control Association 33:884-887.

Linzon, S.N., W.W. Heck, and F.D.H. MacDowall. 1975. Effects of photochemical oxidants on vegetation. In: Photochemical Air Pollution: Formation, Transport and Effects. National Research Council of Canada, Report No. 14096, Pages 89-142.

Lonneman, W.A., J.J. Buffalini, and R.L. Sella. 1976. PAN and oxidant measurements in ambient atmospheres. Environmental Science and Technology 10:374-380.

Lovelock, J.E. 1977. PAN in the environment, its possible significance in the epidemiology of skin cancer. Ambio 6:131-133.

Mathews, T., P.F. Lester, and R.B. Hicks. 1983. SODAR observations of chinooks and arctic frontal passages across the eastern slopes of the Canadian Rockies. Atmosphere-Ocean 22: 328-342.

Mayrsohn, J.T., and C. Brooks. 1965. The analysis of PAN by electron capture gas chromatography. Presented at the Western Regional Meeting, American Chemical Society. November 18, 1965; Los Angeles, California.

Mudd, J.B. 1963. Enzyme inactivation by peroxyacetyl nitrate. Archives of Biochemistry and Biophysics 102:59-65.

Mudd, J.B. 1966. Reaction of peroxyacyl nitrate with glutathione. Journal of Biological Chemistry 241:4077-4080.

Mudd, J.B. 1975. Peroxyacetyl nitrates. In: Responses of Plants to Air Pollution, (ed.) J.B. Mudd and T.T. Kozlowski. Academic Press, New York, New York. Pp. 97-119.

Mudd, J.B., R. Leavitt, and W.H. Kersey. 1966. Reaction of peroxyacetyl nitrate with sulphydryl groups of proteins. Journal of Biological Chemistry 241:4081-4085.

National Research Council (U.S.). 1977. Ozone and other photochemical oxidants. Washington, D.C.: National Academy of Sciences. 719 pp.

Nicksic, S.W., J. Harkins, and P.K. Mueller, 1967. Some analyses for PAN and studies of its structure. Atmospheric Environment 1:11-18.

Nieboer, H. and J. van Ham. 1976. Peroxyacetyl nitrate (PAN) in relation to ozone and some meteorological parameters at Delft in the Netherlands. Atmospheric Environment 10:115-120.

Nieboer, H., W.P. Carter, A.C. Lloyd, and J.N. Pitts. 1976. The effect of latitude on the potential formation of photochemical smog. Atmospheric Environment 10:731-734.

Nielsen, T., U. Samuelsson, P. Greefelt, and E.L. Thomsen. 1981. Peroxyacetyl nitrate in long-range transported polluted air. Nature 293:533-555.

Okita, T., S. Morimoto, and M. Izawa. 1976. Measurement of gaseous and particulate nitrates in the atmosphere. Atmospheric Environment 10:1085-1089.

Paterson, R.D. 1978. A micrometeorological study of an urban valley. M.Sc. Thesis, The University of Alberta. 91 pp.

Peake, E. 1980. A preliminary study of the chemical composition of particulate matter and aerosols over Calgary. Prep. for Alberta Environment by the Kananaskis Centre for Environmental Research, The University of Calgary. 60 pp.

Peake, E. and H.S. Sandhu. 1983. The formation of ozone and peroxyacetyl nitrate (PAN) in the urban atmospheres of Alberta. Can. J. Chem. 61:927.

Peake, E., M.A. MacLean, and H.S. Sandhu. 1983. Surface ozone and peroxyacetyl nitrate (PAN) observations at rural locations in Alberta, Canada. Journal of the Air Pollution Control Association 33:881-883.

Peake, E., M.A. MacLean, and H.S. Sandhu. 1985. Total inorganic nitrate (particulate nitrate and nitric acid) observations in Calgary, Alberta. Journal of the Air Pollution Control Association 35: 250-253.

Penkett, S.A. 1978. Photochemical air pollution in the U.K. Environment and Pollution Management 8:8-12.

Penkett, S.A., F.J. Sandalls, and M.B.R. Jones. 1977. PAN measurements in England - analytical methods and results. VDI-Berichte Nr. 270:47-54.

Pitts, J.N. 1969. Environmental appraisal: oxidants, hydrocarbons, and oxides of nitrogen. Journal of the Air Pollution Control Association 19:658-667.

Sandhu, H.S. 1975. A study of photochemical air pollutants in the urban airsheds of Edmonton and Calgary. Alberta Department of the Environment, Edmonton. 155 pp.

Schuck, E.A. and E.R. Stephens. 1969. Oxides of nitrogen. Advances in Environmental Science 1:73-118.

Singh, H.B. and L.SJ. Salas. 1983. Methodology for the analysis of peroxyacetyl nitrate (PAN) in the unpolluted atmosphere. Atmospheric Environment 17:1507-1516.

Spicer, C.W. 1974. Fate of nitrogen oxides in the atmosphere. Battelle Columbus Laboratories and U.S. Environmental Protection Agency. (Original not seen; information from Temple and Taylor 1983.)

Spicer, C.W. 1977. Photochemical atmospheric pollutants derived from nitrogen oxides. Atmospheric Environment 11:1089-1095.

Spicer, C.W. 1982. The distribution of oxidized nitrogen in urban air. The Science of the Total Environment 24: 183-192.

Spicer, C.W. 1983. Smog chamber studies of NOx transformation rate and nitrate/precursor relationships. Environmental Science and Technology 17:112-120.

Spicer, C.W. and P. Schumacher. 1977. Interference in sampling atmospheric particulate nitrate. Atmospheric Environment 11:873-876.

Spicer, C.W., G.M. Sverdrup, and M.R. Kuhlman. 1978. Smog chamber studies of NO_x chemistry in power plant plumes. Atmospheric Environment 15:2353-2365.

Stelson, A.W. and J.H. Seinfeld. 1982. Relative humidity and pH dependence of the vapor pressure of ammonium nitrate-nitric acid solutions at 25°C. Atmospheric Environment 16:993-1000.

Stephens, E.R. 1969. The formation, reactions, and properties of peroxyacyl nitrates (PANs) in photochemical air pollution. Advances in Environmental Science 1:119-146.

Stephens, E.R., E.F. Darley, O.C. Taylor, and W.E. Scott. 1960. Photochemical reaction products in air pollution. Proceedings of the American Petroleum Institute. Section III. Chicago, Ill. 40:325-338.

Stephens, E.R., F.R. Burleson, and E.A. Cardiff. 1965. The production of pure peroxyacyl nitrates. Journal of the Air Pollution Control Association 15:87-89.

Sticksel, R.R. 1975. The stratosphere as a source of surface ozone. Presented at the 68th Annual Meeting of the Air Pollution Control Association. June 15-20; Boston, Massachusetts.

Taylor, O.C. 1969. Importance of peroxyacetyl nitrate (PAN) as a phytotoxic air pollutant. Journal of the Air Pollution Control Association 19:347-351.

Taylor, O.C. 1973. Acute responses of plants to aerial pollutants. In: Air Pollution Damage to Vegetation, (ed.) J.A. Naegele. Advances in Chemistry Series 122, pp. 9-20.

Taylor, O.C., D.B. Drummond, and P.R. Miller. 1974. Acceptable limits of air pollution dosage and vegetation effects: peroxyacyl nitrates. Presented at 67th Air Pollution Control Association Annual Meeting. Denver, Colorado, June 9-13. pp. E1-E14.

Taylor, O.C., and D.C. MacLean. 1970. Nitrogen oxides and peroxyacyl nitrates. In: Recognition of Air Pollution Injury to Vegetation: A Pictoral Atlas, (eds.) J.S. Jacobsen and A.C. Hill. Pittsburgh, PA. Air Pollution Control Association.

Temple, P.J. and O.C. Taylor. 1983. World wide ambient measurements of peroxyacetyl nitrate (PAN) and implications for plant injury. Atmospheric Environment 17:1431-1438.

Tingey, D.T. and A.C. Hill. 1968. The occurrence of photochemical phytotoxicants in the Salt Lake Valley. Utah Academy of Science Proceedings 44:387-395.

Tuazon, E.C., A.M. Winer, and J.N. Pitts. 1981. Trace pollutant concentrations in a multiday smog episode in the California southcoast air basin by long path length Fourier transform infrared spectroscopy. Environmental Science and Technology 10:1232-1237.

Wendschuh, P.H., H. Fuhr, J.S. Goffney, and J.N. Pitts. 1973. Reaction of peroxyacetyl nitrate with amines. Chemical Communications 1973:74-75.

Westberg, H., K. Allwine, and E. Robinson. 1978. Measurements of light hydrocarbons and studies of oxidant transport beyond urban areas. Research Triangle Park, NC: U.S. Environmental Protection Agency, Office of Research and Development. (Original not seen; information from Temple and Taylor 1983.)

9. APPENDICES

9.1 CONCENTRATIONS OF PAN IN THE EDMONTON AMBIENT ATMOSPHERE, DECEMBER 1982 TO MAY 1984

Table 13. PAN concentrations in downtown Edmonton, December 1982 (ppb).

Day	17	18	19	20	21	22	23	24
Time								
0030						<0.15	<0.15	
0100						<0.15	<0.15	
0130						<0.15	<0.15	
0200						<0.15	<0.15	
0230						<0.15	<0.15	
0300						<0.15	<0.15	
0330						<0.15	<0.15	
0400						<0.15	<0.15	
0430						<0.15	<0.15	
0500						<0.15	<0.15	
0530						<0.15	<0.15	
0600						<0.15	<0.15	
0630						<0.15	<0.15	
0700						<0.15	<0.15	
0730						<0.15	<0.15	
0800						<0.15	0.15	
0830						<0.15	<0.15	
0900						<0.15	<0.15	
0930						<0.15	<0.15	
1000						<0.15	<0.15	
1030						<0.15	<0.15	
1100						<0.15	<0.15	
1130						<0.15	0.15	
1200						<0.15	0.18	
1230						<0.15	0.20	
1300						<0.15	0.18	
1330						<0.15	0.17	
1400					<0.15	<0.15	0.20	
1430					<0.15	<0.15	0.24	
1500					<0.15	<0.15	0.23	
1530					<0.15	<0.15	0.22	
1600					<0.15	<0.15	0.24	
1630					<0.15	<0.15	<0.15	
1700					<0.15	<0.15		
1730					<0.15	<0.15		
1800					0.15	<0.15		
1830					<0.15	<0.15		
1900					<0.15	<0.15		
1930					<0.15	<0.15		
2000					<0.15	<0.15		
2030					<0.15	<0.15		
2100					<0.15	<0.15		
2130					<0.15	<0.15		
2200					<0.15	<0.15		
2230					<0.15	<0.15		
2300					<0.15	<0.15		
2330					<0.15	<0.15		
2400					<0.15	<0.15		

continued...

Table 13. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030						<0.15	<0.15
0100						<0.15	<0.15
0130						<0.15	<0.15
0200						<0.15	<0.15
0230						<0.15	<0.15
0300						<0.15	<0.15
0330						<0.15	<0.15
0400						<0.15	<0.15
0430						<0.15	<0.15
0500						<0.15	<0.15
0530						<0.15	<0.15
0600						<0.15	<0.15
0630						<0.15	<0.15
0700						<0.15	<0.15
0730						<0.15	<0.15
0800						<0.15	<0.15
0830						<0.15	<0.15
0900						<0.15	<0.15
0930						<0.15	<0.15
1000						<0.15	<0.15
1030						<0.15	<0.15
1100						<0.15	<0.15
1130						<0.15	<0.15
1200					<0.15	<0.15	<0.15
1230					<0.15	<0.15	<0.15
1300					<0.15	<0.15	<0.15
1330					<0.15	<0.15	<0.15
1400					<0.15	<0.15	<0.15
1430					<0.15	0.17	<0.15
1500					<0.15	0.15	0.20
1530					<0.15	<0.15	0.19
1600					<0.15	<0.15	<0.15
1630					<0.15	<0.15	0.15
1700					<0.15	<0.15	<0.15
1730					<0.15	<0.15	<0.15
1800					<0.15	<0.15	<0.15
1830					<0.15	<0.15	<0.15
1900					<0.15	<0.15	<0.15
1930					<0.15	<0.15	<0.15
2000					<0.15	<0.15	<0.15
2030					<0.15	<0.15	<0.15
2100					0.15	<0.15	<0.15
2130					<0.15	<0.15	<0.15
2200					<0.15	<0.15	<0.15
2230					<0.15	<0.15	<0.15
2300					<0.15	<0.15	<0.15
2330					<0.15	<0.15	<0.15
2400					0.15	<0.15	<0.15

Table 14. PAN concentrations in downtown Edmonton, January 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	<0.15	<0.15	0.24	<0.15	0.14	<0.15	0.22	<0.15
0100	<0.15	<0.15	0.23	<0.15	<0.15	<0.15	0.22	<0.15
0130	<0.15	<0.15	0.27	<0.15	<0.15	<0.15	0.24	<0.15
0200	<0.15	<0.15	0.23	<0.15	0.15	<0.15	0.18	<0.15
0230	<0.15	<0.15	0.20	0.15	<0.15	<0.15	0.19	<0.15
0300	<0.15	0.15	0.24	<0.15	<0.15	<0.15	0.14	<0.15
0330	<0.15	0.15	0.22	<0.15	0.15	<0.15	0.24	<0.15
0400	<0.15	<0.15	0.18	<0.15	<0.15	<0.15	0.21	<0.15
0430	<0.15	<0.15	0.18	<0.15	<0.15	<0.15	0.17	<0.15
0500	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	0.18	<0.15
0530	<0.15	0.17	<0.15	<0.15	<0.15	<0.15	0.25	<0.15
0600	<0.15	<0.15	0.15	<0.15	<0.15	<0.15	0.15	<0.15
0630	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.19	<0.15
0700	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.17	<0.15
0730	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0800	<0.15	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0830	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	0.16	<0.15
0900	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0930	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	0.15	<0.15
1000	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
1030	<0.15	<0.15	<0.15		0.15	<0.15	<0.15	<0.15
1100	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
1130	<0.15		<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
1200	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	0.20	<0.15
1230	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
1300	<0.15	0.22	<0.15	0.16	0.15	0.17	<0.15	0.16
1330	<0.15	0.22	<0.15	<0.15	<0.15	0.20	<0.15	0.18
1400	<0.15	0.28	<0.15	<0.15	<0.15	0.17	0.15	<0.15
1430	<0.15	0.34	0.15	0.15	<0.15	0.15	0.17	0.15
1500	0.15	0.29	<0.15	0.18	<0.15	<0.15	<0.15	<0.15
1530	<0.15	0.28	<0.15	0.20	<0.15	<0.15	<0.15	<0.15
1600	<0.15	0.34	0.15	0.17	0.19	0.21	<0.15	<0.15
1630	0.15	0.32	<0.15	0.17	0.19	0.24	0.15	<0.15
1700	<0.15	0.25	<0.15	0.16	0.15	0.24	<0.15	<0.15
1730	<0.15	0.22	<0.15	0.15	0.15	0.16	<0.15	<0.15
1800	<0.15	0.23	<0.15	<0.15	0.16	0.22	<0.15	<0.15
1830	<0.15	0.22	<0.15	0.15	<0.15	0.15	<0.15	<0.15
1900	<0.15	0.23	<0.15	0.14	<0.15	0.18	<0.15	<0.15
1930	<0.15	0.31	<0.15		<0.15	0.18	<0.15	<0.15
2000	<0.15	0.32	<0.15	0.18	<0.15	0.18	<0.15	<0.15
2030	<0.15	0.22	<0.15	0.20	<0.15	0.25	<0.15	<0.15
2100	<0.15	0.29	<0.15	0.18	0.15	0.28	<0.15	<0.15
2130	<0.15	0.24	<0.15	0.20	<0.15	0.18	<0.15	<0.15
2200	<0.15	0.28	<0.15	0.17	<0.15	0.24	<0.15	<0.15
2230	<0.15	0.28	<0.15	0.16	<0.15	0.23	<0.15	<0.15
2300	<0.15	0.27	<0.15	0.14	<0.15	0.15	<0.15	<0.15
2330	<0.15	0.16	<0.15	0.20	<0.15	0.29	<0.15	<0.15
2400	<0.15	0.27	<0.15	0.18	<0.15	0.18	<0.15	<0.15

continued...

Table 14. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.22	
0100	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0130	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.17	
0200	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.15	
0230	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.15	
0300	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.15	
0330	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0400	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0430	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0500	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0530	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0600	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0630	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0700	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0730	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	
0800	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0830	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0900	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0930	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
1000	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
1030	<0.15	<0.15	0.16	<0.15	<0.15	0.15	<0.15	
1100	<0.15	<0.15	0.18	<0.15	<0.15	<0.15	<0.15	
1130	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.19	
1200	<0.15	<0.15	<0.15	<0.15	<0.15	0.18	<0.15	
1230	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
1300	<0.15	<0.15	0.14	<0.15	<0.15	<0.15	<0.15	
1330	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
1400	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.24	
1430	<0.15	<0.15	<0.15	0.15	<0.15	<0.15	0.16	
1500	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.14	
1530	0.17	<0.15	<0.15	0.15	<0.15	<0.15	0.25	
1600	0.18	<0.15	0.15	<0.15	<0.15	<0.15	0.20	
1630	0.17	<0.15	0.15	<0.15	0.15	<0.15	0.17	
1700	<0.15	0.16	<0.15	<0.15	0.15	<0.15		
1730	0.27	<0.15	<0.15	<0.15	0.15	<0.15		
1800	0.18	<0.15	<0.15	<0.15	0.15	<0.15		
1830	0.16	<0.15	<0.15	<0.15	0.15	<0.15		
1900	0.18	<0.15	<0.15	<0.15	0.15	<0.15		
1930	0.15	<0.15	<0.15	<0.15	0.15	<0.15		
2000	0.18	<0.15	<0.15	<0.15	0.15	<0.15		
2030	<0.15	<0.15	<0.15	<0.15	0.15	<0.15		
2100	<0.15	0.15	<0.15	<0.15	0.15	<0.15		
2130	<0.15	0.15	<0.15	<0.15	0.15	<0.15		
2200	<0.15	<0.15	<0.15	<0.15	0.15	<0.15		
2230	<0.15	<0.15	<0.15	<0.15	0.15	<0.15		
2300	<0.15	<0.15	<0.15	<0.15	0.15	<0.15		
2330	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15		
2400	<0.15	<0.15	<0.15	<0.15	<0.15	0.20		

continued...

Table 14. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030			<0.15	0.24	0.20	<0.15	0.15	<0.15
0100			<0.15	0.21	0.24	<0.15	0.15	<0.15
0130			0.15	0.20	0.22	<0.15	0.15	<0.15
0200			0.14	0.18	0.23	<0.15	0.15	0.18
0230			<0.15	0.19	0.19	<0.15	<0.15	0.22
0300			0.20	0.25	0.24	<0.15	<0.15	0.20
0330			0.19	0.20	0.17	<0.15	<0.15	<0.15
0400			0.18	0.24	0.25	<0.15	<0.15	<0.15
0430			0.15	0.22	0.23	<0.15	<0.15	<0.15
0500			0.18	0.19	0.20	<0.15	<0.15	0.16
0530			<0.15	0.26	0.23	<0.15	<0.15	0.17
0600			0.15	0.20	0.22	<0.15	<0.15	<0.15
0630			<0.15	0.15	0.20	<0.15	<0.15	<0.15
0700			0.17	<0.15	0.22	<0.15	<0.15	0.15
0730			0.17	<0.15	0.20	<0.15	<0.15	<0.15
0800			0.16	0.20	0.27	0.16	<0.15	0.20
0830			<0.15	0.21		<0.15	<0.15	0.20
0900			0.15	0.25		<0.15	<0.15	<0.15
0930			0.18	0.27		<0.15	<0.15	0.18
1000				0.18		0.15	<0.15	0.23
1030			0.16	0.23		<0.15	<0.15	0.20
1100			<0.15	0.28		<0.15	<0.15	0.18
1130			<0.15	0.21		<0.15	<0.15	0.15
1200			0.15	0.25		<0.15	<0.15	0.20
1230			<0.15	0.32		<0.15	<0.15	0.18
1300			0.20	0.38		<0.15	<0.15	0.26
1330			0.14	0.38		<0.15	<0.15	0.30
1400		0.41	0.22	0.43	0.39	0.19	<0.15	0.26
1430		0.35	0.23	0.46	0.39	0.17	<0.15	0.22
1500		0.29	0.24	0.36		0.22	<0.15	0.25
1530		0.29	0.18	0.33		0.22	0.15	0.17
1600		0.43	0.20	0.22		0.19	0.15	0.20
1630		0.36	<0.15	0.29	0.57	.18	<0.15	<0.15
1700		0.36	0.24	0.23	0.40	.18	<0.15	<0.15
1730		0.29	0.15	0.30	0.40	<0.15	<0.15	0.18
1800		0.18	0.19	0.23	0.43	0.22	0.15	<0.15
1830		0.22	0.15	0.24	0.50	0.24	0.15	0.21
1900		0.22	0.26	0.22	0.44	0.20	0.15	0.24
1930		0.19	<0.15	0.20	0.38	<0.15	0.18	0.19
2000		0.19	0.18	0.20	0.36	0.19	<0.15	0.20
2030		0.18	0.18	0.18	0.33	0.15	<0.15	0.15
2100		0.19	0.20	0.18	0.29	0.15	<0.15	0.15
2130		0.20	0.16	0.22	<0.15	0.15	<0.15	0.20
2200		0.14	0.32	0.27	<0.15	<0.15	<0.15	0.23
2230		0.20	0.15	0.21	<0.15	0.20	<0.15	<0.15
2300		0.20	0.24	0.25	<0.15	0.15	<0.15	<0.15
2330		0.20	0.23	0.15	<0.15	<0.15	<0.15	0.15
2400		0.18	0.30	0.18	<0.15	0.15	<0.15	<0.15

continued...

Table 14. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030	<0.15	0.18		0.30	0.17	<0.15	0.61
0100	<0.15	0.20		0.29	<0.15	<0.15	0.52
0130	<0.15	0.22		0.38	<0.15	0.20	0.55
0200	0.18	0.19		0.29	<0.15	0.19	0.54
0230	0.22	0.22		0.33	0.18	<0.15	0.57
0300	0.20	0.16		0.29	0.20	0.19	0.32
0330	<0.15	0.20		0.37	<0.15		0.38
0400	<0.15			0.38	<0.15	0.15	0.43
0430	<0.15	0.20		0.44	0.15	0.15	0.33
0500	0.16			0.37	<0.15	0.15	0.22
0530	0.17	0.17		0.39	<0.15	<0.15	0.43
0600	<0.15	0.18		0.34	<0.15	0.18	0.29
0630	<0.15			0.34	<0.15	<0.15	0.27
0700	0.15	0.20		0.33	<0.15	0.15	0.35
0730	<0.15	0.15		0.31	<0.15	<0.15	0.19
0800	0.20			0.32	<0.15	<0.15	0.28
0830	0.20	<0.15		0.29	<0.15	<0.15	0.31
0900	<0.15	0.18		0.24	<0.15	<0.15	0.22
0930	0.18	0.14		0.32	<0.15	0.18	0.25
1000	0.23			0.29	<0.15	0.31	0.15
1030	0.20	0.22		0.36	0.15	0.15	0.45
1100	0.18	0.24		0.34	<0.15	0.15	0.41
1130	0.15	0.27		0.38	0.18	0.29	0.60
1200	0.20	0.27		0.46	0.27	0.27	0.57
1230	0.18	0.27		0.47	0.25	0.16	0.50
1300	0.26	0.22			0.24	0.21	0.32
1330	0.30	0.18		0.42	0.24	0.20	0.55
1400	0.26	0.20		0.55	0.25	0.20	0.71
1430	0.22	0.18	0.34	0.62	0.37	0.29	0.54
1500	0.25	0.30		0.83	0.30	0.33	0.43
1530	0.17	0.27	0.23	1.04	0.27	0.39	0.43
1600	0.20	0.33	0.31	0.96	0.31	0.36	0.55
1630	<0.15	0.31	0.27	0.75	0.22	0.46	0.47
1700	<0.15		0.25	0.76	0.36	0.45	0.46
1730	0.18		0.29	0.57	0.24	0.39	0.46
1800	<0.15		0.23	0.44	0.34	0.44	0.32
1830	0.21		0.30	0.34	0.25	0.51	0.56
1900	0.24		0.29	0.25	<0.15	0.46	0.55
1930	0.19		0.29	0.34	0.24	0.47	0.66
2000	0.20		0.28	0.20	<0.15	0.51	0.45
2030	0.15		0.27	0.20	0.18	0.60	0.48
2100	0.15		0.28	0.15	0.17	0.56	0.48
2130	0.20		0.27	0.17	<0.15	0.62	0.44
2200	0.33		0.35		0.21	0.61	0.47
2230	<0.15		0.32		0.22	0.62	0.43
2300	<0.15		0.41		<0.15	0.64	0.40
2330	0.15		0.31	0.19	<0.15	0.74	0.42
2400	0.20		0.22	<0.15	0.15	0.61	0.54

Table 15. PAN concentrations in downtown Edmonton, February 1983 (ppb).

Day Time	1	2	3	4	5	6	7	8
0030	0.46	<0.15	<0.15	0.18	0.15	0.37	0.41	0.46
0100	0.55	0.20	<0.15	0.18	0.16	0.36	0.45	0.43
0130	0.52	0.29	<0.15	0.18	0.20	0.36	0.43	0.31
0200	0.48	0.24	<0.15	<0.15	0.18	0.28	0.53	0.43
0230	0.46	0.20	0.17	<0.15	0.18	0.29	0.50	0.47
0300	0.20	0.19	<0.15	0.20		0.33	0.36	0.42
0330	0.23	0.18	<0.15	0.15	0.23	0.34	0.43	0.40
0400	0.22	0.22	0.15	0.18	0.25	0.30	0.41	0.42
0430	0.21	0.24	0.15		0.22	0.29	0.35	0.38
0500		0.20	0.17	0.18	0.15	0.31	0.40	0.32
0530	0.22	0.22	<0.15	<0.15	0.20	0.25	0.34	0.41
0600	0.16	0.29	<0.15	<0.15	0.23	0.20	0.27	0.42
0630	<0.15	0.24	<0.15	<0.15	0.20	0.25	0.35	0.43
0700	<0.15	0.27	<0.15	<0.15	<0.15	0.27	0.38	0.39
0730	<0.15	0.28	0.22	0.15	0.24	0.32	0.36	0.41
0800	0.15	0.25	0.16	0.18	0.24	0.31	0.31	0.46
0830	0.18	0.16	0.17	<0.15	0.23	0.29	0.35	0.41
0900	<0.15	0.24	<0.15	<0.15	0.20	0.33	0.21	0.40
0930	0.22	0.15	<0.15	<0.15	0.22	0.27	0.34	0.49
1000	<0.15	0.20	0.15	0.15	0.22	0.31	0.39	0.45
1030	0.19	0.18	<0.15	0.20	0.20	0.29	0.35	0.40
1100	0.18	0.34	<0.15	<0.15	0.28	0.34	0.34	0.42
1130	0.20	0.17	0.15	<0.15	0.22	0.43	0.24	0.33
1200	0.22	<0.15	<0.15	0.18	0.31	0.55	0.36	0.55
1230	<0.15	0.20	<0.15	0.22	0.34	0.66	0.37	0.46
1300	<0.15	0.20	0.17	0.17	0.32	0.64	0.26	0.53
1330	0.20	0.22	0.18	0.17	0.33	0.84	0.41	0.54
1400	0.15	0.24	0.16	0.19	0.38	0.91	0.35	0.57
1430	<0.15	0.23	0.22	0.15	0.29	0.83	0.44	0.45
1500	<0.15	0.18	0.20	<0.15	0.36	0.63	0.27	0.43
1530	<0.15	<0.15	0.24	<0.15	0.45	0.60	0.41	0.66
1600	0.15	<0.15	0.22	<0.15	0.40	0.59	0.42	0.60
1630	<0.15	0.17	0.24	0.15	0.36	0.66	0.51	0.60
1700	0.18	<0.15	0.25	<0.15	0.36	0.62	0.46	0.54
1730	0.16	<0.15	0.24	0.17	0.32	0.58	0.44	0.50
1800	<0.15	0.17	0.27	0.20	0.32	0.60	0.44	0.62
1830	<0.15	<0.15	0.25	<0.15	0.25	0.61	0.45	0.59
1900	0.20	0.15	0.28	<0.15	0.30	0.60	0.46	0.46
1930	0.23	0.15	0.18	<0.15	0.34	0.61	0.41	0.52
2000	<0.15	<0.15	0.22	<0.15	0.27	0.55	0.48	0.55
2030	0.21	<0.15	0.27	0.18	0.29	0.52	0.43	0.57
2100	0.17	<0.15	0.15	0.17	0.28	0.44	0.49	0.52
2130	0.20	<0.15	0.26	0.16	0.37	0.44	0.43	0.60
2200	<0.15	0.15	0.22	0.20	0.31	0.34	0.40	0.46
2230	0.22	0.17	0.24	<0.15	0.30	0.37	0.38	0.56
2300	0.17	<0.15	0.22	0.22	0.31	0.45	0.42	0.62
2330	0.15	<0.15	0.24	0.18	0.29	0.43	0.43	0.58
2400	0.22	<0.15	<0.15	0.17	0.38	0.32	0.41	0.59

continued...

Table 15. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.59	0.52	0.67				0.18	<0.15
0100	0.63	0.41	0.63				<0.15	<0.15
0130		0.60	0.60				<0.15	<0.15
0200		0.55	0.68				<0.15	<0.15
0230		0.50	0.71				<0.15	<0.15
0300		0.52	0.72				0.17	<0.15
0330		0.41	0.73				0.16	<0.15
0400		0.47	0.64				<0.15	<0.15
0430		0.41	0.67				<0.15	<0.15
0500		0.46	0.66				<0.15	<0.15
0530		0.41	0.66				<0.15	<0.15
0600		0.43	0.66				<0.15	<0.15
0630		0.47	0.64				<0.15	<0.15
0700		0.45	0.56				<0.15	<0.15
0730		0.43	0.52				<0.15	<0.15
0800		0.39	0.54				<0.15	<0.15
0830		0.56	0.45				<0.15	<0.15
0900		0.52	0.48				<0.15	<0.15
0930	0.48	0.56	0.41				<0.15	
1000	0.50	0.60	0.48				<0.15	
1030	0.51	0.51	0.48			0.15	<0.15	
1100	0.46	0.52	0.50				0.30	
1130	0.52	0.58	0.49			0.17	0.24	
1200	0.50	0.43	0.48			0.22	0.16	<0.15
1230	0.71	0.43	0.43			0.17	<0.15	<0.15
1300	0.46	0.48	0.34			0.15	0.21	<0.15
1330	0.47	0.66	0.47			0.28	<0.15	
1400	0.59	0.56	0.37			0.36	0.15	
1430	0.48	0.51				0.38	0.17	
1500		0.46				0.29	<0.15	
1530	0.58	0.40				0.24	<0.15	
1600	0.62	0.43				0.22	0.18	
1630	0.74	0.53				0.30	<0.15	0.15
1700	0.73	0.58				0.47	<0.15	<0.15
1730	0.60	0.56				0.36	<0.15	<0.15
1800	0.50	0.60				0.37	<0.15	<0.15
1830	0.50	0.54				0.29	<0.15	<0.15
1900	0.47	0.54				0.23	<0.15	0.18
1930	0.52	0.64				0.27	<0.15	0.15
2000	0.46	0.67				0.29	<0.15	<0.15
2030	0.52	0.60				0.29	<0.15	0.16
2100	0.42	0.67				0.20	<0.15	<0.15
2130	0.52	0.64				0.29	<0.15	0.19
2200	0.60	0.57				0.18	<0.15	<0.15
2230	0.50	0.64				<0.15	<0.15	<0.15
2300	0.54	0.64				0.23	0.16	<0.15
2330	0.51	0.57				<0.15	<0.15	0.15
2400	0.57	0.65				0.16	<0.15	<0.15

continued...

Table 15. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.16	0.20	0.19	0.21	0.19	<0.15		
0100	<0.15	0.18	0.19	0.23	0.20	0.17		
0130	<0.15	0.17	<0.15	<0.15	0.21	<0.15		
0200	<0.15	0.15	0.18	0.17	<0.15	<0.15		
0230	<0.15	<0.15	0.29	0.18	<0.15	<0.15		
0300	<0.15	0.18	0.23	<0.15	<0.15	<0.15		
0330	<0.15	<0.15	<0.15	0.21	<0.15	<0.15		
0400	0.15	<0.15	0.24	0.16	<0.15	<0.15		
0430	<0.15	0.21	0.23	0.15	<0.15	<0.15		
0500	<0.15	0.15	0.25		<0.15	<0.15		
0530	<0.15	<0.15	0.22	0.18	<0.15	<0.15		
0600	<0.15	<0.15	0.20	<0.15	<0.15	<0.15		
0630	<0.15	<0.15	0.18	<0.15	<0.15	<0.15		
0700	<0.15	0.18	0.23	0.19	<0.15	<0.15		
0730	<0.15	0.20	0.22	<0.15	<0.15	<0.15		
0800	<0.15	0.18	0.20	<0.15	<0.15	<0.15		
0830	<0.15	0.21	0.19	0.15	<0.15	<0.15		
0900	<0.15	0.15	0.19	<0.15	<0.15	<0.15		
0930	0.17	0.20	0.22	<0.15	<0.15	<0.15		
1000	0.18	0.19	0.23	0.23	<0.15	0.16		
1030	<0.15	<0.15	0.30	0.19	<0.15	0.16		
1100	<0.15	0.26	0.32	0.20	<0.15	0.17		
1130	<0.15	<0.15	0.37	0.18	<0.15	0.22		
1200	0.16	0.27	0.34	0.22	0.16	0.15		
1230	<0.15		0.34	0.26	0.15	0.28		
1300	0.15	0.17	0.40	0.31	<0.15	0.26		
1330	<0.15	<0.15	0.36	0.30	<0.15	0.24		
1400	0.16	<0.15	0.42	0.43	<0.15	0.18		
1430	0.15	<0.15	0.40	0.66	<0.15	0.29		
1500	0.19	<0.15	0.39	0.76	<0.15	0.24		
1530	0.17	<0.15	0.36	0.71	<0.15	0.22		
1600	0.18	0.16	0.50	0.78	<0.15	0.21		
1630	0.19	0.16	0.53	0.84	<0.15	0.19		
1700	0.24	0.16	0.47	0.75	<0.15	0.23		
1730	0.22	0.18	0.52	0.84	<0.15	0.23		
1800	0.24	0.16	0.56	0.65	<0.15	<0.15		
1830	<0.15	0.16	0.58	0.61	<0.15	0.23		
1900	0.19	0.15	0.48	0.58		0.19		
1930	<0.15	0.24	0.43	0.63	0.18	0.17		
2000	0.18	0.25	0.39	0.54	<0.15	0.22		
2030	0.19	0.25	0.41	0.44	<0.15	0.18		
2100	0.23	0.21	0.42	0.41	<0.15			
2130	0.17	0.23	0.38	0.29	<0.15			
2200	0.17	0.24	0.39	0.37	<0.15			
2230	0.18	0.22	0.29	0.27	<0.15			
2300	0.18	0.23	0.21	0.22	0.15			
2330	0.16	0.18	0.18	0.22	0.22			
2400	<0.15	0.15	0.21	0.16	<0.15			

continued...

Table 15. Concluded.

Day	25	26	27	28
Time				
0030				
0100				
0130				
0200				
0230				
0300				
0330				
0400				
0430				
0500				
0530				
0600				
0630				
0700				
0730				
0800				
0830				
0900				
0930				
1000				0.23
1030				0.22
1100				0.30
1130				0.25
1200				0.29
1230				0.23
1300				0.27
1330				0.29
1400				0.20
1430				0.27
1500				0.29
1530				0.26
1600				0.30
1630				0.31
1700				0.32
1730				0.39
1800				0.31
1830				0.36
1900				0.30
1930				0.27
2000				0.38
2030				0.28
2100				0.30
2130				0.34
2200				0.30
2230				0.32
2300				0.30
2330				0.28
2400				

Table 16. PAN concentrations in downtown Edmonton, March 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	0.29	0.40	0.30	0.42	<0.15	<0.15		0.22
0100	0.30	0.32	0.31	0.38	<0.15	<0.15		0.20
0130	0.35	0.52	0.34	0.33	<0.15	<0.15		0.20
0200	0.37	0.38	0.29	0.40	<0.15	<0.15		0.16
0230	0.44	0.43	0.32	0.42	<0.15	<0.15		0.25
0300	0.40	0.37	0.35	0.37	<0.15	<0.15		0.21
0330	0.40	0.36	0.36	0.24	0.26	<0.15		0.18
0400	0.33	0.28	0.39	0.24	<0.15	<0.15		0.22
0430	0.28	0.38	0.38	0.39	<0.15	<0.15		0.20
0500	0.29	0.30	0.32	0.29	<0.15	<0.15		0.19
0530	0.25	0.30	0.37	0.33	<0.15	<0.15		0.20
0600	0.22	0.35	0.30	0.22	<0.15	<0.15		0.21
0630	0.26	0.31	0.33	0.34	<0.15	<0.15		0.21
0700	0.27	0.38	0.35	0.38	<0.15	<0.15		0.27
0730	0.32	0.38	0.32	0.37	<0.15	<0.15		0.20
0800	0.29	0.37	0.35	0.42	<0.15	<0.15		0.19
0830	0.38	0.45	0.37	0.34	<0.15	<0.15		0.22
0900	0.29	0.39	0.31	0.41	<0.15	<0.15		0.34
0930	0.31	0.36	0.40	0.35	<0.15	<0.15		0.21
1000	0.30	0.32	0.39	0.37	<0.15	<0.15		0.24
1030	0.35	0.32	0.43	0.30	<0.15	<0.15		0.28
1100	0.37	0.32	0.37	0.39	<0.15	<0.15		0.23
1130	0.36	0.30	0.45	0.35	<0.15	<0.15	0.34	0.16
1200	0.38	0.33	0.38		<0.15	<0.15	0.33	0.21
1230	0.39	0.26	0.50	0.37	<0.15	<0.15	0.35	0.25
1300	0.32	0.33	0.42	0.36	<0.15	<0.15	0.30	0.22
1330		0.34	0.48	0.47	<0.15	<0.15	0.36	0.29
1400		0.40	0.57	0.44	<0.15	<0.15	0.40	0.28
1430	0.44	0.30	0.47	0.41	<0.15	<0.15	0.35	0.30
1500	0.44	0.37	0.51	0.36	<0.15	<0.15	0.42	0.35
1530	0.40	0.23	0.54	0.35	<0.15	<0.15	0.33	0.34
1600	0.43	0.30	0.53	0.40	<0.15	<0.15	0.28	0.37
1630	0.38	0.34	0.45	0.35	<0.15	<0.15	0.19	0.26
1700	0.48	0.35	0.39	0.29	<0.15		0.36	0.35
1730	0.49	0.37	0.47	<0.15	<0.15		0.26	0.32
1800	0.47	0.32	0.53	<0.15	<0.15		0.34	0.32
1830	0.46	0.33	0.47	<0.15	<0.15		0.30	0.36
1900	0.51	0.30	0.52	<0.15	<0.15		0.33	0.33
1930	0.42	0.33	0.59	<0.15	<0.15		0.36	0.39
2000	0.44	0.34	0.49	<0.15	<0.15		0.25	0.41
2030	0.44	0.34	0.48	<0.15	<0.15		0.24	0.42
2100	0.35	0.32	0.53	<0.15	<0.15		0.27	0.46
2130	0.33	0.29	0.44	<0.15	<0.15		0.24	0.44
2200	0.37	0.27	0.51	<0.15	<0.15		0.28	0.34
2230	0.39	0.33	0.40	<0.15	<0.15		0.15	0.33
2300	0.35	0.38	0.42	<0.15	<0.15		0.24	0.31
2330	0.36	0.24	0.46	<0.15	<0.15		0.20	0.36
2400	0.31	0.34	0.41	<0.15	<0.15		0.20	0.38

continued...

Table 16. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.37		0.62	0.38	0.16	<0.15	0.22	0.22
0100	0.42		0.58	0.36	0.24	<0.15	<0.15	0.20
0130	0.36		0.51	0.39	0.29	<0.15	0.24	0.18
0200	0.33		0.60	0.35	0.21	<0.15	0.26	0.14
0230	0.28		0.49	0.29	0.22	<0.15	0.22	0.20
0300	0.27		0.48	0.35	0.19	0.16	0.25	0.16
0330	0.32		0.46	0.26	0.27	0.17	0.19	0.19
0400	0.25		0.54	0.30	0.25	<0.15	<0.15	<0.15
0430	0.26		0.43	0.26	0.28	0.17	0.20	0.16
0500	0.24		0.39	0.22	0.27	<0.15	0.17	0.17
0530	0.25		0.41	0.25	0.33	<0.15	0.18	0.19
0600	0.21		0.38	0.22	0.27	<0.15	0.15	0.14
0630	0.21		0.34	0.15	0.26	<0.15	0.17	0.22
0700	0.29		0.25	0.20	0.30	<0.15	<0.15	0.23
0730	0.17	0.27	0.30	0.22	0.26	0.16	0.18	
0800	0.23	0.33	0.26	0.15	0.30	<0.15	0.21	0.15
0830	0.28	0.31	0.27	0.20	0.30	<0.15	0.22	0.16
0900	0.25	0.33	0.31	0.20	0.38	<0.15	0.21	0.25
0930	0.24	0.39	0.39	0.21	0.41	<0.15	0.21	
1000	0.18	0.25	0.31	0.27	0.41		<0.15	
1030	0.26	0.34	0.27	0.27	0.40	<0.15	<0.15	
1100	0.27	0.42	0.43	0.27	0.42	0.16	0.21	
1130	0.20	0.45	0.39	0.39	0.36	0.15	0.20	
1200	0.24	0.46	0.39	0.47	0.31	0.20	0.22	
1230	0.19	0.53	0.47	0.47	0.29	<0.15	0.16	<0.15
1300	0.26	0.33	0.42	0.46	0.32	0.21	0.15	<0.15
1330	0.25	0.42	0.42	0.40	0.24	0.23	0.24	<0.15
1400	0.24	0.60	0.50	0.49	0.36	<0.15	0.18	0.22
1430	0.35	0.49	0.52	0.48	0.30	<0.15	0.14	0.22
1500	0.30	0.28	0.48	0.48	0.28	0.19	0.22	0.23
1530		0.38	0.54	0.49	0.25	0.22	0.20	0.27
1600		0.40	0.58	0.52	0.25	0.28	<0.15	0.25
1630		0.47	0.58	0.65	0.18	0.23	0.21	0.23
1700		0.51	0.59	0.28	0.18	0.30	0.17	0.22
1730		0.38	0.57	0.34	0.19	0.27	0.15	0.22
1800		0.20	0.50	0.43	0.25	0.18	0.17	0.27
1830		0.42	0.49	0.31	0.20	0.26	0.19	0.27
1900		0.42	0.48	0.33	0.20	0.18	<0.15	0.26
1930		0.44	0.50	0.28	0.20	0.21	0.20	0.27
2000		0.39	0.52	0.23	0.18	<0.15	<0.15	0.25
2030		0.50	0.48	0.29	<0.15	0.27	<0.15	0.27
2100		0.52	0.53	0.24	0.22	0.21	0.17	0.27
2130		0.42	0.53	0.18	<0.15	0.21	0.17	0.28
2200		0.47	0.47	0.18	<0.15	0.29	<0.15	0.27
2230		0.53	0.44	0.19	<0.15	0.17	0.16	0.27
2300		0.48	0.43	0.18	<0.15	0.21	0.20	0.22
2330		0.58	0.49	0.22	<0.15	0.25	0.19	0.27
2400		0.55	0.42	0.22	<0.15	0.16	<0.15	0.27

continued...

Table 16. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.25	0.26	0.31	0.35	0.46	0.55	0.57	0.79
0100	0.27	0.27	0.34	0.38	0.58	0.54	0.58	0.89
0130	0.20	0.26	0.33	0.33	0.51	0.52	0.53	0.84
0200	0.23	0.29	0.42	0.41	0.51	0.51	0.58	0.77
0230	0.23	0.30	0.37	0.37	0.49	0.52	0.54	0.79
0300	0.23	0.26	0.31	0.35	0.59	0.47	0.53	0.81
0330	0.24	0.27	0.34	0.37	0.51	0.49	0.50	0.70
0400	0.19	0.29	0.31	0.38	0.43	0.47	0.55	0.63
0430	0.18	0.22	0.32	0.38	0.34	0.51	0.57	0.58
0500	0.17	0.30	0.31	0.42	0.31	0.44	0.48	0.65
0530	0.19	0.28	0.32	0.40	0.31	0.47	0.57	0.62
0600	0.17	0.25	0.30	0.44	0.32	0.53	0.52	0.65
0630	0.17	0.27	0.32	0.43	0.34	0.51	0.45	0.69
0700	0.25	0.23	0.27	0.39	0.32	0.57	0.48	0.69
0730	0.28	0.29	0.32	0.30	0.31	0.55	0.53	0.64
0800	0.16	0.24	0.24	0.36	0.33	0.61	0.64	0.68
0830		0.28	0.23	0.41	0.27	0.61	0.59	0.66
0900		0.21	0.29	0.29	0.36	0.57	0.57	0.54
0930		0.28	0.31	0.36	0.24	0.51	0.69	0.49
1000		0.22	0.28	0.35	0.33	0.55	0.68	0.50
1030		0.34	0.32	0.44	0.31	0.62	0.82	0.47
1100		0.30	0.22	0.37	0.43	0.56	0.84	0.44
1130		0.32	0.38	0.40	0.43	0.58	0.82	0.51
1200		0.17	0.29	0.45	0.49	0.65	0.94	0.45
1230		0.23	0.23	0.37	0.47	0.67	0.82	0.51
1300		0.24	0.33	0.41	0.41	0.70	0.81	0.47
1330		0.36	0.40	0.38	0.47	0.65	0.91	0.51
1400	0.33	0.30	0.38	0.40	0.47	0.66	0.92	0.54
1430	0.31	0.32	0.37	0.44	0.43	0.65	0.97	0.53
1500	0.24	0.22	0.31	0.34	0.51	0.66	1.00	0.58
1530	0.23	0.39	0.31	0.42	0.42	0.63	0.87	0.54
1600	0.29	0.34	0.38	0.42	0.48	0.60	0.96	0.61
1630	0.32	0.31	0.35	0.49	0.54	0.63	0.87	0.62
1700	0.30	0.30	0.34	0.40	0.49	0.57	0.96	0.62
1730	0.34	0.40	0.31	0.39	0.44	0.62	0.86	0.62
1800	0.36	0.26	0.37	0.38	0.44	0.55	0.81	0.64
1830	0.36	0.27	0.39	0.42	0.52	0.62	0.76	0.50
1900	0.37	0.27	0.38	0.38	0.48	0.66	0.95	0.56
1930	0.38	0.28	0.45	0.45	0.44	0.58	0.90	0.60
2000	0.37	0.32	0.47	0.52	0.49	0.69	0.81	0.60
2030	0.37	0.27	0.43	0.55	0.40	0.60	0.85	0.44
2100	0.38	0.30	0.42	0.53	0.54	0.57	0.89	0.57
2130	0.35	0.27	0.43	0.61	0.44	0.62	0.93	0.56
2200	0.34	0.38	0.43	0.54	0.43	0.58	1.00	0.45
2230	0.33	0.39	0.44	0.62	0.48	0.55	0.89	0.56
2300	0.37	0.38	0.43	0.55	0.53	0.67	0.82	0.46
2330	0.32	0.32	0.40	0.58	0.48	0.55	0.72	0.40
2400	0.30	0.33	0.40	0.59	0.36	0.57	0.82	0.45

continued...

Table 16. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030	0.38	0.52	0.47	0.30	0.64	0.48	0.31
0100	0.54	0.53	0.49	0.33	0.54	0.48	0.32
0130	0.77	0.47	0.50	0.32	0.57	0.47	0.31
0200	0.54	0.41	0.43	0.30	0.59	0.40	0.29
0230	0.49	0.47	0.42	0.27	0.59	0.40	0.33
0300	0.47	0.47	0.45	0.27	0.58	0.40	0.29
0330	0.46	0.44	0.46	0.22	0.65	0.38	0.28
0400	0.47	0.41	0.40	0.28	0.56	0.37	0.26
0430	0.45	0.49	0.45	0.22	0.63	0.38	0.28
0500	0.43	0.41	0.41	0.26	0.61	0.38	0.29
0530	0.46	0.42	0.36	0.27	0.57	0.33	0.29
0600	0.41	0.36	0.44	0.25	0.58	0.36	0.27
0630	0.46	0.39	0.37	0.41	0.60	0.41	0.33
0700	0.57	0.34	0.39	0.46	0.58	0.39	0.37
0730	0.51	0.44	0.40	0.52	0.59	0.43	0.32
0800	0.46	0.44	0.49	0.44	0.57	0.42	0.31
0830	0.55	0.42	0.43	0.52	0.56	0.41	0.39
0900	0.49	0.43	0.42	0.50	0.59	0.39	0.33
0930	0.49	0.47	0.35	0.52	0.61	0.41	0.48
1000	0.44	0.50	0.43	0.58	0.62	0.43	0.43
1030	0.47	0.57	0.38	0.61	0.62	0.37	0.45
1100	0.49	0.58	0.44	0.58	0.61	0.36	0.51
1130	0.48	0.66	0.45	0.66	0.56	0.35	0.47
1200	0.48	0.69	0.44	0.65	0.54	0.35	0.51
1230	0.53	0.82	0.41	0.68	0.51	0.33	0.49
1300	0.51	0.89	0.47	0.66	0.50	0.29	0.48
1330	0.51	0.81	0.47	0.66	0.53	0.39	
1400	0.56	0.95	0.49	0.67	0.52	0.35	0.63
1430	0.62	0.85	0.41	0.66	0.53	0.35	0.47
1500	0.63	0.92	0.50	0.68	0.53	0.34	0.59
1530	0.62	0.91	0.41	0.69	0.54	0.36	0.80
1600	0.64	0.95	0.39	0.69	0.56	0.33	
1630	0.69	1.09	0.36	0.68	0.56	0.32	0.48
1700	0.54	1.02	0.44	0.69	0.54	0.32	0.48
1730	0.63	0.95	0.36	0.70	0.55	0.34	0.47
1800	0.62	0.90	0.37	0.72	0.55	0.35	0.60
1830	0.59	0.95	0.31	0.73	0.53	0.35	0.68
1900	0.63	1.12	0.42	0.73	0.53	0.32	0.70
1930	0.57	1.11	0.44	0.72	0.50	0.38	0.75
2000	0.58	1.01	0.42	0.77	0.55	0.35	0.88
2030	0.61	1.06	0.33	0.70	0.51	0.33	0.62
2100	0.61	0.87	0.32	0.78	0.51	0.36	0.62
2130	0.60	0.86	0.27	0.74	0.50	0.33	0.56
2200	0.64	0.74	0.28	0.73	0.52	0.37	0.52
2230	0.58	0.62	0.29	0.67	0.55	0.29	0.53
2300	0.48	0.65	0.36	0.66	0.52	0.30	0.50
2330	0.54	0.56	0.29	0.65	0.46	0.31	0.49
2400	0.49	0.52	0.36	0.64	0.48	0.32	0.44

Table 17. PAN concentrations in downtown Edmonton, April 1983 (ppb).

Day Time	1	2	3	4	5	6	7	8
0030	0.44	0.24	0.27	0.28	0.30	0.28	0.31	<0.15
0100	0.48	0.26	0.21	0.24	0.27	0.29	0.31	<0.15
0130	0.45	0.24	0.29	0.23	0.25	0.20	0.27	<0.15
0200	0.38	0.24	0.28	0.28	0.27	0.32	0.30	0.15
0230	0.37	0.24	0.28	0.29	0.23	0.38	0.30	<0.15
0300	0.37	0.29	0.31	0.27	0.26	0.34	0.29	<0.15
0330	0.27	0.23	0.21	0.28	0.24	0.27	0.31	<0.15
0400	0.27	0.25	0.22	0.28	0.24	0.26	0.35	<0.15
0430	0.24	0.21	0.27	0.30	0.25	0.27	0.31	<0.15
0500	0.23	0.21	0.28	0.28	0.30	0.26	0.31	<0.15
0530	0.22	0.19	0.26	0.24	0.28	0.23	0.33	0.15
0600	0.21	0.21	0.29	0.28	0.26	0.17	0.31	<0.15
0630	0.21	0.18	0.28	0.25	0.22	0.26	0.32	0.17
0700	0.22	0.21	0.33	0.24	0.21	0.19	0.26	0.15
0730	0.19	0.17	0.30	0.17	0.27	0.28	0.29	0.17
0800	0.18	0.18	0.37	0.24	0.24	0.20	0.29	0.19
0830	0.18	0.17	0.25	0.22	0.24	0.28	0.40	0.19
0900	0.20	0.21	0.29	0.25	0.25	0.28	0.40	0.20
0930	0.24	0.19	0.31	0.45	0.21	0.25	0.36	0.24
1000	0.18	0.23	0.32	0.47	0.24	0.26	0.34	0.24
1030	0.20	0.23	0.35	0.50	0.21	0.26	0.34	<0.15
1100	0.29	0.19	0.39	0.59	0.25	0.28	0.36	<0.15
1130	0.21	0.21	0.40	0.60	0.22	0.34	0.31	0.18
1200	0.23	0.19	0.33	0.64	0.25	0.26	0.41	0.21
1230	0.23	0.18	0.32	0.47	0.28	0.30	0.41	0.20
1300	0.17	0.20	0.27	0.46	0.23	0.34	0.48	0.19
1330	0.23	0.26	0.33	0.45	0.26	0.21	0.50	0.19
1400	0.25	0.25	0.33	0.45	0.28	0.27	0.44	0.19
1430	0.23	0.26	0.32	0.45	0.25	0.22	0.46	0.19
1500	0.20	0.23	0.29	0.45	0.20	0.21	0.41	<0.15
1530	0.20	0.27	0.28	0.44	0.28	0.25	0.38	0.19
1600	0.22	0.28	0.27	0.45	0.24	0.20	0.39	0.19
1630	0.23	0.24	0.28	0.47	0.23	0.24	0.39	0.19
1700	0.23	0.28	0.26	0.47	0.26	0.22	0.40	0.19
1730	0.23	0.31	0.28	0.48	0.28	0.34	0.40	0.22
1800	0.28	0.24	0.32	0.51	0.28	0.37	0.43	0.17
1830	0.29	0.28	0.31	0.43	0.28	0.37	0.37	0.23
1900	0.25	0.20	0.33	0.42	0.26	0.41	0.34	0.18
1930	0.24	0.28	0.31	0.41	0.36	0.35	0.21	0.20
2000	0.30	0.24	0.26	0.41	0.34	0.37	0.22	0.21
2030	0.26	0.26	0.29	0.38	0.30	0.31	0.22	0.22
2100	0.25	0.28	0.31	0.33	0.28	0.34	<0.15	<0.15
2130	0.25	0.21	0.27	0.28	0.33	0.34	<0.15	0.15
2200	0.26	0.27	0.27	0.28	0.32	0.33	<0.15	<0.15
2230	0.24	0.21	0.28	0.29	0.28	0.32	<0.15	<0.15
2300	0.23	0.25	0.28	0.25	0.24	0.30	<0.15	<0.15
2330	0.30	0.24	0.30	0.32	0.38	0.31	<0.15	0.17
2400	0.23	0.21	0.30	0.30	0.36	0.32	<0.15	<0.15

continued...

Table 17. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.18	0.18	0.25	0.32	0.40	0.28	0.26	0.25
0100	0.17	0.25	0.22	0.31	0.41	0.20	0.24	0.29
0130	0.20	0.23	0.22	0.37	0.35	0.26	0.25	0.22
0200	0.19	0.26	0.22	0.28	0.38	0.27	0.22	0.28
0230	<0.15	0.24	0.26	0.24	0.38	0.19	0.22	0.18
0300	<0.15	0.27	0.26	0.31	0.34	0.23	0.25	0.26
0330	<0.15	0.24	0.24	0.30	0.36	0.23	0.18	0.21
0400	0.15	0.25	0.25	0.30	0.35	0.17	0.23	0.23
0430	<0.15	0.27	0.26	0.30	0.32	0.19	0.21	0.20
0500	<0.15	0.23	0.25	0.33	0.27	0.20	0.17	0.21
0530	<0.15	0.21	0.29	0.30	0.27	0.23	0.20	0.25
0600	<0.15	0.20	0.23	0.26	0.29	0.24	0.18	0.27
0630	0.15	0.24	0.26	0.28	0.26	0.21	0.16	0.27
0700	<0.15	0.26	0.27	0.31	0.27	0.25	0.19	0.27
0730	<0.15	0.20	0.28	0.31	0.31	0.25	0.19	0.24
0800	<0.15	0.19	0.28	0.31	0.28	0.28	0.17	0.28
0830	<0.15	0.22	0.28	0.31	0.27	0.26	0.28	0.27
0900	<0.15	0.21	0.30	0.26	0.25	0.22	0.28	0.23
0930	<0.15	0.24	0.29	0.30	0.22	0.26	0.38	0.27
1000	0.19	0.19	0.30	0.32	0.25	0.27	0.51	0.22
1030	0.18	0.21	0.28	0.23	0.23	0.27	0.56	0.21
1100	0.19	0.22	0.24	0.30	0.22	0.26	0.59	0.23
1130	0.23	0.20	0.32	0.28	0.25	0.18	0.52	0.24
1200	0.21	0.26	0.31	0.32	0.26	0.27	0.53	0.26
1230	0.21	0.20	0.23	0.33	0.18	0.23	0.42	0.29
1300	0.21	0.24	0.29	0.29	0.25	0.20	0.38	0.28
1330	0.18	0.23	0.33	0.32	0.26	0.23	0.39	0.24
1400	0.28	0.26	0.29	0.37	0.26	0.24	0.34	0.27
1430	0.28	0.22	0.28	0.41	0.26	0.24	0.27	0.25
1500	0.32	0.26	0.24	0.37	0.23	0.27	0.33	0.26
1530	0.21	0.30	0.25	0.43	0.25	0.27	0.34	0.26
1600	0.27	0.25	0.26	0.49	0.30	0.25	0.39	0.24
1630	0.26	0.30	0.31	0.48	0.26	0.19	0.32	0.21
1700	0.23	0.27	0.29	0.54	0.28	0.21	0.34	0.21
1730	0.26	0.26	0.30	0.54	0.32	0.19	0.37	0.22
1800	0.24	0.26	0.35	0.48	0.32	0.19	0.35	0.20
1830	0.29	0.20	0.29	0.56	0.32	0.28	0.34	0.22
1900	0.33	0.20	0.30	0.58	0.35	0.31	0.34	0.28
1930	0.30	0.27	0.31	0.56	0.33	0.25	0.39	0.28
2000	0.27	0.25	0.27	0.50	0.36	0.25	0.46	0.30
2030	0.22	0.27	0.31	0.53	0.38	0.26	0.42	0.30
2100	0.23	0.24	0.32	0.44	0.33	0.20	0.43	0.26
2130	0.21	0.26	0.30	0.44	0.29	0.24	0.35	0.25
2200	0.17	0.24	0.33	0.45	0.25	0.23	0.31	0.24
2230	0.26	0.24	0.31	0.43	0.27	0.29	0.33	0.18
2300	0.26	0.21	0.29	0.44	0.22	0.28	0.34	0.25
2330	0.23	0.24	0.33	0.40	0.24	0.22	0.34	0.24
2400	0.22	0.20	0.31	0.41	0.29	0.25	0.31	0.25

continued...

Table 17. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.24	0.29	0.32	0.28	0.35	0.35	0.35	0.52
0100	0.22	0.24	0.20	0.25	0.33	0.35	0.40	0.48
0130	0.23	0.24	0.21	0.24	0.33	0.23	0.35	0.33
0200	0.23	0.24	0.22	0.28	0.33	0.24	0.33	0.37
0230	0.20	0.24	0.27	0.31	0.33	0.25	0.30	0.28
0300	0.18	0.24	0.27	0.29	0.31	0.22	0.31	0.27
0330	0.21	0.20	0.21	0.35	0.36	0.19	0.28	0.25
0400	0.21	0.21	0.23	0.33	0.35	0.20	0.31	0.19
0430	0.18	0.15	0.18	0.30	0.33	0.21	0.32	0.19
0500	0.22	0.18	0.22	0.30	0.36	0.18	0.37	0.17
0530	0.20	0.20	0.23	0.27	0.41	0.23	0.31	0.15
0600	0.17	0.24	0.35	0.31	0.43	0.24	0.30	0.18
0630	<0.15	0.19	0.35	0.31	0.45	0.20	0.36	0.20
0700	<0.15	0.15	0.32	0.32	0.47	0.27	0.41	<0.15
0730	0.19	0.22	0.27	0.31	0.49	0.28	0.43	0.18
0800	0.22	0.24	0.32	0.41	0.52	0.33	0.32	0.20
0830	0.18	0.25		0.43	0.54	0.43	0.38	0.20
0900	<0.15	0.22		0.41	0.48	0.34	0.46	0.29
0930	<0.15	0.26		0.41	0.50	0.24	0.40	0.27
1000	<0.15	0.30		0.45	0.49	0.27	0.47	0.33
1030	<0.15	0.28		0.44	0.60	0.29	0.45	0.30
1100	0.20		0.98	0.43	0.72	0.21	0.40	0.36
1130	0.16	0.22	0.70	0.40	0.52	0.22	0.39	0.35
1200	0.21	0.22	0.22	0.45	0.51	0.22	0.44	0.38
1230	0.19	0.21		0.52	0.52	0.24	0.45	0.34
1300	0.26	0.19		0.49	0.52	0.30	0.49	0.37
1330	0.33	0.24	0.28	0.40	0.48	0.28	0.52	0.38
1400	0.27	0.16	0.29	0.42	0.60	0.33	0.51	0.35
1430	0.25	0.24	0.29	0.50	0.62	0.28	0.45	0.35
1500	0.25	0.32	0.35	0.45	0.44	0.35	0.55	0.34
1530	0.22	0.22	0.49	0.42	0.51	0.33	0.49	0.50
1600	0.30	0.23	0.52	0.45	0.56	0.37	0.44	0.28
1630	0.24	0.24	0.47	0.45	0.53	0.42	0.52	0.28
1700	0.24	0.24	0.55	0.52	0.42	0.40	0.49	0.27
1730	0.25	0.24	0.49	0.48	0.47	0.41	0.59	0.20
1800	0.22	0.25	0.42	0.47	0.38	0.46	0.52	0.21
1830	0.26	0.29	0.44	0.51	0.43	0.37	0.47	0.17
1900	0.31	0.31	<0.15	0.47	0.41	0.38	0.46	0.20
1930	0.26	0.33	0.56	0.54	0.37	0.42	0.52	0.19
2000	0.32	0.39	0.45	0.49	0.41	0.43	0.59	0.18
2030	0.37	0.26	0.39	0.49	0.38	0.42	0.55	<0.15
2100	0.32	0.31	0.42	0.44	0.37	0.43	0.47	0.17
2130	0.33	0.27	0.38	0.42	0.31	0.37	0.46	0.16
2200	0.30	0.21	0.32	0.43	0.34	0.40	0.48	0.15
2230	0.32	0.29	0.28	0.38	0.32	0.35	0.62	0.16
2300	0.27	0.26	0.29	0.35	0.37	0.37	0.68	0.22
2330	0.28	0.22	0.24	0.35	0.33	0.34	0.77	0.17
2400	0.29	0.23	0.25	0.41	0.31	0.32	0.66	0.15

continued...

Table 17. Concluded.

Day	25	26	27	28	29	30
Time						
0030	<0.15	0.23		0.31	0.56	0.45
0100	0.16	0.25		0.29	0.53	0.52
0130	0.15	0.26		0.28	0.54	0.41
0200	0.16	0.18		0.28	0.54	0.45
0230	0.15	0.20		0.24	0.49	0.27
0300	0.16	0.20		0.29	0.57	0.22
0330	<0.15	0.17		0.27	0.49	0.21
0400	0.15	0.20		0.28	0.50	0.15
0430	<0.15	0.18		0.26	0.53	0.18
0500	0.15	0.17		0.26	0.51	0.20
0530	<0.15	0.20		0.28	0.53	0.26
0600	0.15	0.16		0.24	0.55	0.35
0630	0.15	0.18		0.34	0.49	0.47
0700	0.15	0.17		0.38	0.54	0.46
0730	0.20	0.16	<0.15	0.38	0.58	0.39
0800	0.19	0.17	0.20	0.32	0.59	0.34
0830	0.24	0.15	0.18	0.44	0.63	0.33
0900	0.25		0.24	0.51	0.64	0.27
0930	0.27	0.19	0.24	0.39	0.59	0.24
1000	0.27	0.19	0.20	0.29	0.60	0.27
1030	0.24	0.21	0.22	0.31	0.66	
1100	0.26	0.17	0.21	0.36	0.58	
1130	0.28	0.19	0.21	0.31	0.57	
1200	0.26	0.19	0.23	0.40	0.54	
1230	0.25	0.18	0.27	0.43	0.51	
1300	0.23	<0.15	0.28	0.44	0.47	
1330	0.23	0.19	0.28	0.43	0.51	
1400	0.24	0.20	0.30	0.48	0.50	
1430	0.26	0.21	0.26	0.54	0.53	
1500	0.24		0.27	0.59	0.51	
1530	0.28		0.32	0.64	0.54	
1600	0.33		0.30	0.70	0.61	
1630	0.28		0.32	0.66	0.57	
1700	0.29		0.30	0.66	0.52	
1730	0.28		0.29	0.79	0.55	
1800	0.27		0.30	0.90	0.60	
1830	0.25		0.31	0.98	0.69	
1900	0.26		0.32	1.13	0.42	
1930	0.26		0.30	1.18	0.42	
2000	0.23		0.34	1.24	0.34	
2030	0.27		0.34	1.21	0.42	
2100	0.26		0.35	0.98	0.52	
2130	0.30		0.34	0.86	0.48	
2200	0.24		0.32	0.67	0.55	
2230	0.28		0.31	0.69	0.55	
2300	0.26		0.29	0.69	0.50	
2330	0.25		0.27	0.70	0.53	
2400	0.25		0.26	0.60	0.51	

Table 18. PAN concentrations in downtown Edmonton, May 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030			0.31	0.38	0.39	<0.15	0.45	0.35
0100			0.25	0.32	0.43	0.17	0.40	0.28
0130			0.28	0.35	0.39	0.17	0.42	0.30
0200			0.24	0.35	0.38	<0.15	0.45	0.33
0230			0.30	0.29	0.34	0.15	0.42	0.30
0300			0.24	0.33	0.37	0.17	0.41	0.36
0330			0.24	0.26	0.39	<0.15	0.39	0.30
0400			0.27	0.24	0.43	0.15	0.33	0.29
0430			0.25	0.23	0.39	0.17	0.31	0.26
0500			0.26	0.18	0.42	0.18	0.36	0.19
0530			0.23	<0.15	0.40	0.18	0.31	0.20
0600			0.24	<0.15	0.40	0.20	0.34	0.20
0630			0.23	<0.15	0.39	<0.15	0.31	0.21
0700			0.25	0.17	0.38	0.15	0.25	0.18
0730			0.26	<0.15	0.31	<0.15	0.27	0.19
0800			0.24	0.15	0.28	<0.15	0.28	0.20
0830			0.28	0.16	0.29	0.16	0.33	0.25
0900		0.43	0.27	0.17	0.31	0.16	0.35	0.16
0930		0.27	0.27	<0.15	0.34	0.17	0.39	0.20
1000		0.21	0.27	<0.15	0.32	0.16	0.35	0.24
1030		0.19	0.32	<0.15	0.38	0.20	0.27	0.25
1100		0.23	0.28	<0.15	0.40	0.23	0.22	0.24
1130		0.20	0.25	<0.15	0.39	0.24	0.19	0.22
1200		0.17	0.30	0.16	0.39	0.32	0.19	0.25
1230		0.17	0.30	0.16	0.38	0.36	0.22	0.23
1300		0.15	0.28	<0.15	0.44	0.37	0.21	0.25
1330		0.21	0.25	0.18	0.46	0.43	0.21	0.25
1400		0.19	0.21	0.19	0.45	0.42	0.24	0.28
1430		0.23	0.29	0.16	0.46	0.46	0.21	0.26
1500		0.31	0.28	0.23	0.40	0.60	0.29	0.24
1530		0.29	0.27	0.19	0.40	0.63	0.23	0.24
1600		0.28	0.33	0.26	0.41	0.69	0.22	0.25
1630		0.35	0.36	0.34	0.40	0.61	0.24	0.24
1700		0.30	0.35	0.27	0.52	0.61	0.23	0.21
1730		0.25	0.35	0.28	0.55	0.61	0.29	0.24
1800		0.26	0.31	0.25	0.61	0.55	0.28	0.21
1830		0.23	0.34	0.31	0.52	0.52	0.29	0.23
1900		0.23	0.29	0.26	0.57	0.48	0.37	0.19
1930		0.21	0.28	0.26	0.69	0.46	0.32	0.20
2000		0.19	0.19	0.29	0.46	0.46	0.30	0.21
2030		0.24	0.15	0.25	0.40	0.45	0.34	0.19
2100		0.23	0.24	0.27	0.36	0.45	0.37	0.19
2130		0.22	0.29	0.31	0.32	0.44	0.37	0.18
2200		0.24	0.21	0.27	0.28	0.45	0.40	0.16
2230		0.28	0.17	0.35	0.30	0.41	0.40	0.15
2300		0.28	0.35	0.35	0.19	0.42	0.37	0.16
2330		0.25	0.37	0.35	0.21	0.40	0.39	<0.15
2400		0.23	0.42	0.41	<0.15	0.44	0.33	0.15

continued...

Table 18. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	<0.15	0.18	0.41		0.33			
0100	<0.15	0.20	0.40		0.42			
0130	<0.15	0.20	0.45		0.43			
0200	<0.15	<0.15	0.33		0.48			
0230	<0.15	0.20	0.31		0.47			
0300	<0.15	0.19	0.30		0.37			
0330	<0.15	0.17	0.28		0.34			
0400	<0.15	0.20	0.27					
0430	<0.15	0.18	0.26					
0500	<0.15	0.18	0.27					
0530	<0.15	0.17	0.24					
0600	0.15	0.15	0.27					
0630	0.17	0.15	0.33					
0700	<0.15	0.21	0.34					
0730	<0.15	0.20	0.33					
0800	0.16	0.18	0.42					
0830	0.15	0.23	0.41					0.22
0900	<0.15	0.18	0.37					0.28
0930	0.18	0.20	0.36					0.26
1000	<0.15	0.20	0.48					0.23
1030	0.15	0.22	0.51					0.21
1100	<0.15	0.22	0.36					0.18
1130	<0.15	0.23	0.35					0.18
1200	0.15	0.27	0.40					0.18
1230	0.16	0.23	0.39					0.16
1300	<0.15	0.25	0.43	0.42				0.18
1330	0.17	0.29	0.43	0.43				0.22
1400	0.17	0.26	0.45					0.26
1430	0.18	0.24	0.45	0.50				0.21
1500	0.18	0.24	0.40	0.60				0.25
1530	0.17	0.23	0.46	0.68				0.21
1600	0.19	0.20	0.50	0.70				0.21
1630	0.18	0.20	0.44	0.71				0.21
1700	0.18	0.22	0.47	0.77				0.21
1730	0.20	0.24	0.49	0.71				0.20
1800	0.22	0.22	0.47	0.58				0.18
1830	0.20	0.25	0.44	0.49				0.21
1900	0.21	0.25	0.46	0.50				0.17
1930	0.20	0.22	0.54	0.39				0.22
2000	0.23	0.20	0.46	0.38				0.19
2030	0.20	0.23	0.42	0.38				0.19
2100	0.23	0.26	0.43	0.38				0.23
2130	0.22	0.32	0.37	0.42				0.20
2200	0.23	0.24	0.39	0.38				0.21
2230	0.21	0.24	0.35	0.39				0.22
2300	0.20	0.39	0.36	0.39				0.26
2330	0.20	0.52	0.41	0.40				0.22
2400	0.23	0.34		0.35				0.26

continued...

Table 18. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.20		0.27	0.22	<0.15	<0.15	0.18	0.19
0100	0.23		0.20	0.20	<0.15	0.15	<0.15	0.19
0130	0.22		0.19	0.15	<0.15	<0.15	0.18	<0.15
0200	0.23		0.19	<0.15	<0.15	<0.15	0.15	0.15
0230	0.21		0.20	0.17	<0.15	<0.15	0.16	0.18
0300	0.25		0.16	<0.15	<0.15	<0.15	0.19	0.16
0330	0.21		<0.15		<0.15	<0.15	0.20	0.18
0400	0.19		<0.15		<0.15	<0.15	0.18	0.18
0430	0.17		<0.15		<0.15	<0.15	0.15	<0.15
0500	0.17		<0.15		<0.15	<0.15	0.20	0.20
0530	0.17		<0.15		<0.15	<0.15	0.24	0.19
0600	0.16		0.16		<0.15	0.15	0.17	0.21
0630	0.15		0.22		<0.15	<0.15	<0.15	0.20
0700	0.19		0.15		<0.15	0.15	0.16	0.26
0730	<0.15		0.20		<0.15	<0.15	0.16	0.29
0800	<0.15		0.23		<0.15	<0.15	0.21	0.34
0830	0.20		0.15	<0.15	<0.15	<0.15	0.18	0.33
0900	0.22		<0.15	<0.15	<0.15	0.17	0.16	0.34
0930	0.16		<0.15	<0.15	<0.15	0.17	0.17	0.26
1000	0.25		0.16	<0.15	<0.15	0.24	0.16	0.21
1030	0.25		<0.15	0.16	<0.15	0.26	<0.15	0.27
1100	0.22		0.17	0.16	<0.15	0.27	<0.15	0.33
1130	0.24		0.15	<0.15	<0.15	0.19	0.17	0.33
1200	0.29		0.16	<0.15	<0.15	0.19	0.17	0.41
1230	0.26		<0.15	<0.15	<0.15	0.19	0.17	0.40
1300	0.18		0.18	<0.15	<0.15	0.17	<0.15	0.43
1330	0.21	<0.15	0.21	<0.15	0.15	0.18	0.15	0.43
1400	0.19	0.20	0.19	<0.15	<0.15	0.22	<0.15	0.49
1430	<0.15	0.20	0.15	<0.15	<0.15	0.20	<0.15	0.47
1500	0.15	0.21	0.16	<0.15	<0.15	0.20	<0.15	0.46
1530	<0.15	0.18	0.15	<0.15	<0.15	0.28	0.16	0.42
1600	<0.15	0.20	<0.15	<0.15	0.15	0.24	<0.15	0.38
1630	0.16	0.18	0.15	<0.15	<0.15	0.23	<0.15	0.37
1700	<0.15	0.23	<0.15	<0.15	<0.15	0.28	<0.15	0.38
1730	<0.15	0.25	0.15	<0.15	0.15	0.23	0.15	0.35
1800	0.16	0.15	<0.15	<0.15	0.16	0.22	0.17	0.34
1830	0.16	0.24	0.17	<0.15	<0.15	0.22	0.17	0.32
1900	0.18	0.20	0.16	0.16	<0.15	0.18	0.17	0.34
1930	0.17	0.20	0.16	<0.15	0.22	0.17	0.15	0.43
2000	0.20	0.21	0.21	<0.15	0.17	0.19	0.20	0.42
2030		0.26	0.20	<0.15	0.18	0.19	0.16	0.46
2100		0.22	0.20	<0.15	0.16	0.16	0.19	0.44
2130		0.25	0.22	<0.15	0.15	0.15	0.17	0.39
2200		0.23	0.20	<0.15	0.15	0.15	0.19	0.43
2230		0.24	0.25	<0.15	0.16	0.17	0.19	0.44
2300		0.24	0.20	<0.15	<0.15	0.18	0.21	0.43
2330		0.24	0.20	<0.15	0.17	<0.15	0.17	0.41
2400		0.24	0.20	<0.15	0.17	0.17	0.18	0.41

continued...

Table 18. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030	0.36	<0.15		0.56	0.34	0.33	0.45
0100	0.38	<0.15		0.46	0.34	0.35	0.42
0130	0.34	0.15		0.49	0.26	0.31	0.37
0200	0.31	<0.15		0.49	0.36	0.37	0.32
0230	0.25	<0.15		0.45	0.30	0.37	0.36
0300	0.22	0.15		0.45	0.27	0.33	0.37
0330	0.24	0.19		0.39	0.29	0.34	0.33
0400	<0.15	<0.15		0.58	0.24	0.27	0.33
0430	0.18	<0.15		0.53	0.27	0.36	0.35
0500	0.18	0.22		0.45	0.28	0.34	0.32
0530	<0.15	0.24		0.47	0.28	0.20	0.41
0600	0.15	0.24		0.52	0.33	0.31	0.45
0630	0.24	0.20		0.58	0.43	0.28	0.46
0700	0.26	0.20		0.67	0.60	0.27	0.49
0730	0.24	0.19		0.75	0.63	0.36	0.50
0800	0.24	0.19	0.58	1.22	0.87	0.33	<0.15
0830	0.34		0.34	0.52	0.86	0.42	<0.15
0900	0.27		0.44	0.67	0.94	0.41	<0.15
0930	0.17		0.27	0.69	0.70	0.42	<0.15
1000	0.20		0.28	0.66	0.61	0.46	
1030	0.21		0.15	0.71	0.91	0.47	
1100	0.24		0.28	0.73	0.67	0.46	
1130	0.28	0.27	0.37	0.74	0.49	0.43	
1200	<0.15	0.25	0.36	0.79	0.50	0.54	
1230	0.17		0.37	0.79	0.37	0.54	
1300	0.22		0.44	0.79	0.35	0.55	
1330	0.32		0.49	0.81	0.33	0.57	
1400	0.26		0.35	0.82	0.32	0.50	
1430	0.24		0.40	0.81	0.41	0.57	
1500	0.21	0.42	0.37	0.77	0.34	0.54	
1530	0.25	0.59	0.34	0.72	0.27	0.60	
1600	0.25	0.63	0.39	0.61	0.21	0.58	
1630	0.28	0.48	0.37	0.64	0.21	0.61	
1700	0.22	0.51	0.40	0.65	0.29	0.58	
1730	0.25	0.44	0.32	0.63	0.21	0.55	
1800	0.31	0.52	0.38	0.68	0.17	0.59	
1830	0.22	0.41	0.39	0.58	0.20	0.53	
1900	<0.15	0.43	0.35	0.61	0.28	0.53	
1930	<0.15	0.39	0.40	0.57	0.20	0.55	
2000	<0.15	0.31	0.39	0.76	0.16	0.59	
2030	<0.15	0.31	0.44	0.72	0.27	0.64	
2100	<0.15	0.35	0.44	0.63	0.37	0.58	
2130	<0.15		0.41	0.57	0.29	0.58	
2200	<0.15		0.63	0.57	0.25	0.48	
2230	0.15		0.37	0.55	0.22	0.46	
2300	0.17		0.38	0.52	0.30	0.40	
2330	0.15		0.39	0.48	0.27	0.40	
2400	<0.15		0.45	0.42	0.37	0.35	

Table 19. PAN concentrations in downtown Edmonton, June 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030								
0100								
0130								
0200								
0230								
0300								
0330								
0400								
0430								
0500								
0530								
0600								
0630								
0700								
0730								
0800								
0830								
0900								
0930								
1000								
1030								
1100								
1130								
1200								
1230								
1300								
1330								
1400								
1430								
1500								
1530								
1600								
1630								
1700								
1730								
1800								
1830								
1900								
1930								
2000								
2030								
2100								
2130								
2200								
2230								
2300								
2330								
2400								

continued...

Table 19. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030								
0100								
0130								
0200								
0230								
0300								
0330								
0400								
0430								
0500								
0530								
0600								
0630								
0700								
0730								
0800								
0830								
0900								
0930								
1000								
1030								0.17
1100								0.16
1130								
1200								
1230								
1300								
1330								
1400								
1430								2.49
1500								2.67
1530								2.99
1600								1.85
1630								1.91
1700								0.96
1730								0.93
1800								0.83
1830								0.96
1900								1.00
1930								1.04
2000								1.25
2030								1.21
2100								1.12
2130								1.31
2200								1.10
2230								1.00
2300								0.67
2330								0.68
2400								

continued...

Table 19. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.60	0.23	0.24	<0.15			0.55	0.33
0100	0.53	0.19	0.20	<0.15			0.27	0.29
0130	0.45	0.17	<0.15	<0.15			0.38	0.24
0200	0.52	0.16	<0.15	<0.15			0.42	0.23
0230	0.43	0.16	<0.15	<0.15			0.23	0.22
0300	0.42	<0.15	<0.15	<0.15			0.20	0.27
0330	0.30	<0.15	<0.15	<0.15			0.25	0.28
0400	0.30	0.17	<0.15	<0.15			0.27	0.28
0430	0.35	0.17	<0.15	<0.15			0.33	0.27
0500	0.32	0.15	<0.15	0.23			0.28	0.22
0530	0.40	0.28	<0.15	<0.15			0.22	0.31
0600	0.35	0.20	<0.15	0.26			0.35	0.26
0630	0.39	0.21	<0.15	0.15			0.41	0.22
0700	0.40	<0.15	<0.15	0.17			0.33	0.19
0730	0.42	<0.15	<0.15	<0.15			0.21	0.23
0800	0.50	0.25	<0.15	<0.15			0.17	0.30
0830	0.48	<0.15	<0.15	<0.15			0.31	0.43
0900	0.53	0.27	<0.15	<0.15			0.30	0.43
0930	0.56	0.24	<0.15	0.16			0.38	0.44
1000	0.51	0.25	<0.15	<0.15			0.30	0.40
1030	0.51	0.23	<0.15	0.22			0.40	0.44
1100	0.43	0.24	<0.15	<0.15			0.42	0.50
1130	0.41	0.24	<0.15	0.25			0.55	0.46
1200	0.45	0.41	<0.15	0.22			0.57	0.46
1230	0.52	0.29	<0.15	<0.15			0.56	0.53
1300	0.44	0.29	<0.15	<0.15			0.49	0.57
1330	0.45	0.31	<0.15	0.23			0.45	0.65
1400	0.51	0.41	<0.15	<0.15		0.31	0.51	0.58
1430	0.63	0.49	<0.15	0.19		0.32	0.52	0.64
1500	0.47	0.31	<0.15	0.15		0.28	0.53	0.69
1530	0.49	0.34	<0.15	0.28		0.36	0.66	0.92
1600	0.63	0.22	<0.15	0.24		0.25	0.54	0.73
1630	0.78	0.17	<0.15	0.32		0.33	0.51	0.59
1700	0.83	0.33	<0.15	0.36		0.29	0.66	0.74
1730	0.28	0.34	<0.15	0.22		0.31	0.60	0.61
1800	0.15	0.31	<0.15	0.29		0.43	0.52	0.52
1830	0.32	0.28	<0.15	0.29		0.24	0.62	0.57
1900	0.27	0.19	<0.15	0.24		0.25	0.58	0.52
1930	0.24	0.17	<0.15	0.20		0.18	0.64	0.57
2000	0.25	<0.15	<0.15	0.30		0.28	0.63	0.66
2030	0.24	<0.15	<0.15	0.19		0.31	0.62	0.63
2100	0.26	0.20	<0.15	0.23		0.31	0.70	0.44
2130	0.27	0.23	<0.15	0.18		0.18	0.71	0.39
2200	0.23	0.22	<0.15	0.25		0.26	0.59	0.34
2230	0.30	0.21	<0.15	0.24		0.43	0.50	0.46
2300	<0.15	0.18	<0.15	0.22		0.53	0.44	0.28
2330	0.31	<0.15	<0.15	<0.15		0.40	0.42	0.33
2400	0.29	<0.15	<0.15	0.20		0.59	0.27	0.32

continued...

Table 19. Concluded.

Day	25	26	27	28	29	30
Time						
0030	0.37	<0.15	0.19	0.43	0.33	0.72
0100	0.34	<0.15	0.17	0.47	0.36	1.01
0130	0.21	<0.15	<0.15	0.50	0.32	0.54
0200	0.25	<0.15	0.24	0.47	0.50	0.63
0230	0.33	0.16	<0.15	0.52	0.33	0.69
0300	0.24	<0.15	0.20	0.74	0.49	0.61
0330	0.23	0.20	<0.15	0.44	0.40	1.18
0400	0.17	<0.15	<0.15	0.67	0.31	0.54
0430	<0.15	<0.15	<0.15	0.67	0.34	0.28
0500	<0.15	<0.15	0.23	0.45	0.29	0.42
0530	<0.15	<0.15	0.26	0.72	0.28	0.99
0600	0.29	<0.15	<0.15	0.35	0.36	0.45
0630	0.16	<0.15	<0.15	0.49	0.40	0.34
0700	0.17	0.21	0.22	0.40	0.35	0.36
0730	0.23	<0.15	0.26	0.27	0.51	0.19
0800	<0.15	<0.15	0.24	0.31	0.52	0.29
0830	0.21	<0.15	0.31	0.49	0.84	<0.15
0900	<0.15	<0.15	0.19	0.51	0.88	0.54
0930	<0.15	0.16	0.34	0.56	1.45	0.28
1000	0.23	0.33	0.53	0.66	1.33	0.47
1030	0.22	0.36	0.46	0.80	2.06	0.37
1100	0.28	0.40	0.41	0.76	1.69	0.32
1130	0.23	0.56	0.34	0.63	1.07	0.69
1200	0.18	0.50	0.49	1.09	1.02	0.47
1230	0.26	0.38	0.50	1.15	0.98	0.40
1300	<0.15	0.42	0.48	1.21	1.12	0.51
1330	0.19	0.42	0.55	1.61	0.91	0.48
1400	<0.15	0.45	0.49	1.78	0.70	0.63
1430	<0.15	0.36	0.44	2.43	0.80	0.76
1500	<0.15	0.21	0.47	1.76	0.62	0.74
1530	<0.15	0.26	0.44	1.66	0.54	0.79
1600	<0.15	0.28	0.50	1.75	0.55	0.72
1630	<0.15	0.30	0.59	1.84	0.54	0.43
1700	<0.15	0.34	0.56	1.54	0.37	0.52
1730	<0.15	0.38	0.62	1.71	0.55	0.56
1800	<0.15	0.16	0.66	1.44	0.50	0.46
1830	<0.15	0.39	0.59	1.19	0.46	0.46
1900	<0.15	0.23	0.64	1.20	0.60	0.34
1930	<0.15	0.34	0.56	0.93	0.57	0.49
2000	<0.15	0.23	0.48	0.89	0.58	0.28
2030	<0.15	0.28	0.44	0.70	0.52	0.35
2100	<0.15	0.15	0.51	0.65	0.59	0.42
2130	0.20	0.23	0.37	0.61	0.68	0.33
2200	<0.15	0.23	0.36	0.45	0.56	0.27
2230	<0.15	0.22	0.34	0.35	0.48	0.37
2300	0.17	0.16	0.37	0.56	0.53	0.30
2330	0.16	0.17	0.43	0.41	0.53	0.43
2400	<0.15	0.22	0.34	0.37	0.62	0.41

Table 20. PAN concentrations in downtown Edmonton, July 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	0.28				0.44	0.17	<0.15	0.36
0100	0.31				0.18	0.25	<0.15	0.24
0130	0.29				0.42	0.18	<0.15	0.36
0200	0.25				0.42	0.23	0.25	0.26
0230	0.26				0.39	0.24	0.19	0.28
0300	0.20				0.22	0.25	0.23	0.24
0330	0.23				0.37	0.23	0.29	0.24
0400	0.28				0.32	0.31	0.19	0.27
0430	0.24				0.25	0.20	0.26	0.32
0500	0.22				0.27	0.27	0.27	0.25
0530	0.30				0.24	0.15	0.33	0.30
0600	0.22				0.29	0.35	0.21	0.39
0630	0.26				0.34	0.30	0.25	0.31
0700	<0.15				0.35	0.31	0.31	0.32
0730	0.21				0.36	0.31	0.32	0.30
0800	0.33				0.33	0.36	0.43	0.31
0830	0.34				0.34	0.38	0.40	0.44
0900	0.32				0.34	0.49	0.61	0.38
0930	0.17				0.48	0.55	0.67	0.51
1000	0.30			0.50	0.72	0.53	0.68	0.43
1030	0.42			0.60	0.85	0.57	0.68	0.64
1100	0.47			0.73	1.08	0.64	0.49	0.56
1130	0.50			0.95	1.07	0.76	0.43	0.57
1200	0.39			1.01	1.40	0.97	0.29	0.50
1230	0.55			0.93	1.21	0.98	0.53	0.40
1300	0.45			1.00	1.23	0.78	0.55	0.38
1330	0.59			0.99	0.85	0.66	0.68	0.47
1400	0.56			0.99	0.72	0.54	0.62	0.35
1430	0.52			0.96	0.52	0.62	0.71	0.54
1500	0.43			0.90	0.70	0.60	0.79	0.64
1530	0.40			0.81	0.56	0.57	0.84	0.55
1600	0.35			0.81	0.59	0.61	0.95	0.62
1630	0.43			0.66	0.48	0.64	0.80	0.70
1700	0.31			0.79	0.45	0.64	0.77	0.60
1730	0.47			0.78	0.46	0.64	0.60	0.37
1800	0.38			0.68	0.49	0.53	0.59	0.35
1830	0.52			0.50	0.45	0.51	0.68	0.35
1900	0.46			0.66	0.38	0.49	0.85	0.36
1930	0.56			0.75	0.49	0.50	0.84	0.36
2000	0.37			0.57	0.50	0.44	0.68	0.33
2030				0.49	0.43	0.51	0.57	0.29
2100				0.57	0.34	0.34	0.46	0.37
2130				0.59	0.38	0.36	0.51	0.22
2200				0.55	0.52	0.31	0.42	0.31
2230				0.54	0.32	0.16	0.34	0.30
2300				0.63	0.42	<0.15	0.46	0.27
2330				0.58	0.40	<0.15	0.35	0.21
2400				0.50	0.22	0.17	0.33	0.28

continued...

Table 20. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.34	0.28	0.37	0.50	0.28	0.29	<0.15	<0.15
0100	0.23	0.22	0.30	0.59	0.31	0.34	0.16	<0.15
0130	0.35	0.15	0.21	0.54	0.25	0.31	<0.15	<0.15
0200	0.28	<0.15	0.26	0.77	0.26	0.38	<0.15	<0.15
0230	0.32	0.15	0.24	0.52	0.15	0.28	<0.15	<0.15
0300	0.39	<0.15	0.18	0.61	0.21	0.27	<0.15	0.17
0330	0.27	<0.15	0.25	0.52		0.33	<0.15	0.17
0400	0.24	0.19	0.22	0.44		0.26	<0.15	0.24
0430	0.23	<0.15	0.17	0.48		0.28	<0.15	<0.15
0500	0.24	<0.15	0.21	0.46		0.30	<0.15	0.23
0530	0.35	<0.15	<0.15	0.44		0.27	<0.15	<0.15
0600	0.30	<0.15	<0.15	0.33		0.19	0.18	0.17
0630	<0.15	0.19	0.16	0.32		0.22	<0.15	<0.15
0700	0.15	0.21	0.15	0.42		0.16	<0.15	<0.15
0730	0.19	0.32	0.27	0.23	0.43	0.19	<0.15	<0.15
0800	<0.15	0.19	0.41	0.37	0.53	0.22	<0.15	<0.15
0830	0.21	0.28	0.42		0.54	0.17	0.17	<0.15
0900	0.33	0.31	0.53		0.58	0.25	<0.15	<0.15
0930	0.21	0.33	0.83	0.22	0.45	0.25	<0.15	<0.15
1000	0.21	0.23	0.49	0.43	0.59	0.27	<0.15	<0.15
1030	0.31	0.17	0.52	0.41	0.63	0.26	<0.15	<0.15
1100	0.28	0.21	0.60	0.33	0.65	0.19	0.19	0.28
1130	0.31	0.31	0.57	0.29	0.60	0.29	<0.15	0.25
1200	0.31	0.28	0.58	0.22	0.62	0.28	<0.15	0.23
1230	0.16	0.25	0.63	0.18	0.66	0.32	0.24	0.25
1300	0.45	0.27	0.65	0.21	0.56	0.31	0.15	0.34
1330	0.30	0.21	0.76	0.39	0.65	0.20	0.16	0.21
1400	0.32	0.20	0.65	0.35	0.68	0.27	0.16	0.23
1430	0.23	0.21	0.41	0.39	0.49	0.19	0.16	0.21
1500	0.22	0.24	0.34	0.20	0.44	0.23	0.16	<0.15
1530	0.32	0.23	0.36	<0.15	0.45	0.27	<0.15	0.26
1600	0.37	0.26	0.23	0.22	0.41	0.32	<0.15	0.17
1630	0.39	0.16	0.43	<0.15	0.41	<0.15	0.16	<0.15
1700	0.34	0.22	0.42	0.18	0.33	0.17	0.20	<0.15
1730	0.39	<0.15	0.51	<0.15	0.38	0.29	<0.15	0.18
1800	0.42	<0.15	0.46	<0.15	0.36	0.27	0.20	0.16
1830	0.35	0.21	0.65	0.19	0.32	0.17	0.15	0.16
1900	0.37	<0.15	0.42	<0.15	0.40	0.20	0.26	0.34
1930	0.39	0.18	0.38	0.25	0.48	0.22	0.19	0.17
2000	0.28	0.20	0.35	0.23	0.41	0.21	<0.15	0.28
2030	0.36	<0.15	0.40	0.21	0.20	0.18	0.15	0.20
2100	0.44	0.21	0.53	0.24	0.34	0.17	<0.15	0.35
2130	0.47	0.27	0.50	0.26	0.40	0.22	<0.15	<0.15
2200	0.35	<0.15	0.55	0.26	0.27	<0.15	0.24	0.20
2230	0.29	0.23	0.60	0.29	0.32	0.16	0.20	0.17
2300	0.27	0.35	0.59	0.26	0.38	0.16	0.21	0.31
2330	0.30	<0.15	0.45	0.29	0.32	0.15	<0.15	0.21
2400	0.24	0.22	0.59	0.21	0.37	<0.15	<0.15	0.19

continued...

Table 20. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.27	0.22	0.26	0.34	0.55	0.16	0.36	0.30
0100	0.20	0.24	0.42	0.33	0.54	0.16	0.43	0.23
0130	0.20	0.19	0.55	0.36	0.47	<0.15	0.37	0.22
0200	0.19	0.26	0.37	0.36	0.49	<0.15	0.35	0.17
0230	0.19	0.23	0.33	0.41	0.45	<0.15	0.32	0.28
0300	0.18	0.16	0.28	0.53	0.40	0.20	0.33	0.26
0330	<0.15	0.17	0.31	<0.15	0.26	<0.15	0.25	0.23
0400	0.16	0.30	0.30	0.25	0.24	<0.15	0.29	0.15
0430	<0.15	0.22	0.32	0.43	0.27	<0.15	0.40	0.30
0500	0.16	0.21	0.44	0.36	0.21	<0.15	0.31	0.26
0530	<0.15	0.20	0.34	0.46	0.27	<0.15	0.25	0.24
0600	<0.15	0.32	0.34	0.80	0.35	0.17	0.34	0.29
0630	<0.15	0.28	0.41	0.49	0.32	0.18	0.24	0.28
0700	<0.15	0.28	0.37	0.35	0.29	0.19	0.29	0.23
0730	<0.15	0.27	0.45	0.36	<0.15	<0.15	0.39	0.30
0800	0.20	0.27	0.50	0.57	<0.15	0.17	0.34	<0.15
0830	<0.15	0.32	0.59	0.56		0.23	0.26	0.16
0900	<0.15	0.42	0.63	0.46		0.19	0.38	0.19
0930	<0.15	0.28	0.84	0.44		0.27	0.40	0.25
1000	<0.15	0.33	1.07	0.55	<0.15	0.26	0.41	0.16
1030	<0.15	0.30	1.48	0.51	<0.15	0.20	0.44	0.25
1100	0.21	0.42	1.43	0.47	<0.15	0.42	0.54	0.24
1130	0.24	0.66	1.47	0.53	<0.15	0.40	0.49	0.34
1200	0.17	0.54	1.41	0.61	0.15	0.46	0.46	0.45
1230	<0.15	0.53	1.40	0.62	0.20	0.51	0.61	0.53
1300	0.18	0.73	1.66	0.62	0.16	0.55	0.42	0.45
1330	0.21	0.55	1.61	0.65	<0.15	0.62	0.61	0.50
1400	0.16	0.66	1.22	0.71	<0.15	0.68	0.54	0.45
1430	<0.15	0.92	1.10	0.63	0.15	0.41	0.54	0.35
1500	<0.15	0.79	0.75	0.69	0.18	0.64	0.55	0.45
1530	0.21	0.77	0.99	0.55	0.18	0.87	0.47	0.37
1600	0.21	0.78	0.79	0.64	<0.15	0.56	0.49	0.37
1630	0.15	0.82	0.59	0.69	<0.15	0.81	0.42	0.40
1700	<0.15	0.54	0.63	0.69	0.16	0.75	0.55	0.37
1730	0.22	0.43	0.51	0.59	0.20	0.74	0.34	0.32
1800	0.20	0.63	0.43	0.68	<0.15	0.75	0.50	0.36
1830	0.22	0.75	0.50	0.47	<0.15	0.53	0.35	0.42
1900	0.20	0.19	0.43	0.75	0.15	0.55	0.40	0.39
1930	0.26	0.20	0.40	1.14	0.15	0.55	0.22	0.43
2000	0.30	0.27	0.49	0.60	0.20	0.69	0.28	0.53
2030	0.48	0.49	0.45	0.54	<0.15	0.76	0.32	0.38
2100	0.36	0.48	1.38	0.68	<0.15	0.77	0.32	0.47
2130	0.44	0.43	0.80	0.65	<0.15	0.74	0.34	0.31
2200	0.46	0.41	0.55	0.59	0.21	0.79	0.22	0.38
2230	0.29	0.45	0.48	0.53	<0.15	0.61	0.25	0.42
2300	0.22	0.47	0.33	0.43	0.17	0.71	0.29	0.49
2330	0.18	0.41	0.78	0.52	0.16	0.60	0.18	0.41
2400	0.21	0.37	0.69	0.63	<0.15	0.40	0.20	0.41

continued...

Table 20. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030	0.42	0.29	<0.15	<0.15	0.16	<0.15	0.37
0100	0.35	0.31	<0.15	<0.15	0.19	<0.15	0.40
0130	0.37	0.30	<0.15	<0.15	0.22	<0.15	0.32
0200	0.36	0.32	<0.15	<0.15	0.21	<0.15	0.27
0230	0.34	0.32	<0.15	<0.15	0.21	<0.15	0.23
0300	0.27	0.28	<0.15	0.18	0.19	0.19	0.21
0330	0.21	0.30	<0.15	0.23	0.18	<0.15	0.22
0400	0.37	0.29	<0.15	<0.15	0.18	0.16	0.25
0430	0.17	0.32	<0.15	<0.15	<0.15	<0.15	0.23
0500	0.30	0.30	<0.15	<0.15	0.16	<0.15	0.22
0530	0.38	0.25	<0.15	<0.15	<0.15	<0.15	0.22
0600	0.30	0.22	<0.15	<0.15	<0.15	<0.15	0.19
0630	0.31	0.28	<0.15	<0.15	0.16	<0.15	0.20
0700	0.19	0.27	<0.15	<0.15	<0.15	0.16	0.22
0730	0.30	0.18	<0.15	<0.15	0.18	0.17	0.24
0800	<0.15	0.18	<0.15	0.19	0.20	<0.15	0.28
0830	0.24	0.19	<0.15	<0.15	0.19	0.22	0.32
0900	0.16	0.15	<0.15	0.29	0.25	<0.15	0.32
0930	0.26	<0.15	<0.15	<0.15	0.25	<0.15	0.34
1000	0.43	0.17	<0.15	<0.15	0.29	<0.15	0.38
1030	0.57	<0.15	<0.15	<0.15	0.33	0.17	0.39
1100	0.72	<0.15	<0.15	0.27		0.19	0.38
1130	1.63	<0.15	<0.15	0.28	0.31	0.19	0.45
1200	2.92	<0.15	<0.15	0.53	0.23	0.18	0.40
1230	2.36	<0.15	<0.15	0.58	0.28	<0.15	0.40
1300	3.47	<0.15	<0.15		0.28	0.19	0.42
1330	1.63	<0.15	0.16	0.59	0.33	0.36	0.45
1400	1.09	<0.15	0.17	0.58	0.32	0.60	0.41
1430	1.01	<0.15		0.57	0.38	0.55	0.41
1500	0.75	<0.15		0.71	0.45	0.52	0.43
1530	0.95	<0.15		0.71	0.45	0.52	0.34
1600	0.71	<0.15		0.83	0.34	0.56	0.34
1630	0.75	<0.15		0.87	0.41	0.62	0.34
1700	0.55	<0.15		1.08	0.39	0.60	0.34
1730	0.82	<0.15		0.71	0.36	0.44	0.34
1800	0.55	<0.15	0.17	0.54	0.31	0.49	0.33
1830	0.49	<0.15	<0.15	0.56	0.45	0.39	0.30
1900	0.40	<0.15	<0.15	0.72	0.49	0.39	0.29
1930	0.39	<0.15	<0.15	0.57	0.52	0.43	0.29
2000	0.35	<0.15	<0.15	0.86	0.46	0.59	0.29
2030	0.38	<0.15	<0.15	0.53	0.45	0.60	0.24
2100	0.40	<0.15	0.16	0.18	0.40	0.46	0.24
2130	0.39	<0.15	<0.15	0.22	0.28	0.51	0.24
2200	0.39	<0.15	<0.15	0.20	0.19	0.53	0.22
2230	0.38	<0.15	<0.15	0.22	0.20	0.40	0.21
2300	0.37	<0.15	<0.15	0.17	0.17	0.45	0.18
2330	0.32	<0.15	<0.15	<0.15	<0.15	0.42	0.20
2400	0.30	<0.15	<0.15	0.15	<0.15	0.43	0.18

Table 21. PAN concentrations in downtown Edmonton, August 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	0.17	0.18		<0.15	0.34	0.46	0.16	
0100	0.20	0.16		0.15	0.34	0.35	0.17	
0130	0.19	0.16		0.15	0.35	0.32		
0200	<0.15	0.20		0.18	0.45	0.45		
0230	0.15	0.19		<0.15	0.44	0.22		
0300	<0.15	0.20		0.16	0.35	0.30		
0330	<0.15	0.20		<0.15	0.31	0.27		
0400	<0.15	0.21		<0.15	0.48	0.31		
0430	0.18	0.19		<0.15	0.42	0.30		
0500	0.21	0.23		<0.15	0.29	0.30		
0530	0.21	0.23		<0.15	0.25	0.47		
0600	0.22	0.21		<0.15	0.21	0.38		
0630	0.28	0.21		0.15	0.31	0.41		
0700	0.27	0.22		0.15	0.31	0.33		
0730	0.33	0.23		0.21	0.34	0.32		
0800	0.33	0.50	0.30	0.22	0.54	0.32		
0830	0.40	3.18	0.32	0.19	0.56	0.23		0.20
0900	0.42	3.50	0.38	0.24	0.43	0.23		0.28
0930	0.42	1.99	0.45	0.27	0.60	0.23		0.28
1000	0.41	1.97	0.63	0.29	1.82	0.26		0.34
1030	0.42	1.90	0.67	0.38	0.96	0.29		0.43
1100	0.42	1.92	0.70	0.32	1.24	0.27		0.43
1130	0.42	2.11	0.76	0.37	1.26	0.21		0.77
1200	0.42	2.07	0.83	1.18	1.19	0.27		0.89
1230	0.39	2.16	0.84	1.63	1.23	0.23		0.96
1300	0.39		0.83	0.84	0.96	0.29		0.96
1330	0.31		0.89	1.04	0.96	0.28		1.17
1400	0.30		0.82	1.04	0.93	0.31		1.45
1430	0.30		0.67	0.97	0.83	0.32		1.53
1500	0.29		0.88	0.57	0.79	0.34		1.37
1530	0.30		0.82	0.49	0.81	0.33		1.35
1600	0.24		0.60	0.53	0.72	0.34		1.23
1630	0.19		0.92	0.46	0.66	0.42		1.22
1700	0.19		0.83	0.52	0.58	0.32		1.31
1730	0.21		0.29	0.50	0.57	0.41		1.57
1800	0.21		0.27	0.48	0.58	0.37		1.74
1830	0.22		0.20	0.44	0.46	0.41		1.68
1900	0.19		<0.15	0.46	0.53	0.37		1.32
1930	0.19		<0.15	0.48	0.67	0.38		1.17
2000	0.19		0.18	0.64	0.73	0.39		0.93
2030	0.21		0.23	0.87	0.66	0.40		1.49
2100	0.21		0.24	0.84	0.57	0.32		0.69
2130	0.21		0.24	0.82	0.45	0.23		0.50
2200	0.21		0.22	0.66	0.43	0.24		0.62
2230	0.20		0.21	0.64	0.48	0.18		0.45
2300	0.21		0.22	0.61	0.46	0.23		0.39
2330	0.19		0.18	0.66	0.43	0.20		0.37
2400	0.19		0.17	0.73	0.22	0.17		0.39

continued...

Table 21. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.46	0.79	0.16	<0.15	0.18	0.26	0.26	0.46
0100	0.42	0.76	<0.15	<0.15	0.19	0.28	0.25	0.40
0130	0.34	1.04	<0.15	<0.15	0.15	0.28	0.35	0.44
0200	0.29	0.82	<0.15	<0.15	<0.15	0.25	0.42	0.48
0230	0.32	1.24	<0.15	<0.15	<0.15	0.26	0.43	0.53
0300	0.27	0.76	<0.15	<0.15	0.20	0.22	0.33	0.62
0330	0.21	0.60	<0.15	<0.15	0.18	0.22	0.31	0.51
0400	0.23	0.55	<0.15	<0.15	0.18	0.23	0.24	0.47
0430	0.25	0.48	<0.15	<0.15		0.27	0.17	0.53
0500	0.28	0.47	<0.15	<0.15	0.15	0.30	<0.15	0.81
0530	0.27	0.42	<0.15	<0.15	0.17	0.28	0.19	0.52
0600	0.22	0.40	0.16	<0.15	<0.15	0.38	0.22	0.43
0630	0.19	0.39	0.15	<0.15	<0.15	0.34	0.34	0.32
0700	0.19	0.36	0.29	<0.15	<0.15	0.28	0.41	0.47
0730	0.23	0.39	0.25	<0.15	0.33	0.24	0.39	0.46
0800	0.33	0.38	0.27	<0.15	0.45	0.24	0.42	<0.15
0830	0.46	0.42	0.30	<0.15	0.59	0.24	0.42	0.41
0900	0.59	0.41	0.31	<0.15	0.72	0.27	0.45	0.42
0930	0.56	0.47	0.43	<0.15	2.32	0.22	0.41	0.39
1000	0.51	0.58	0.49	<0.15	2.10	0.29	0.36	0.47
1030	0.70	0.60	0.68	<0.15	1.20	0.29	0.38	0.42
1100	0.75	0.49	0.70	<0.15	0.42	0.19	0.33	0.63
1130	0.76	0.55	0.69	0.20	0.59	0.23	0.39	0.70
1200	0.82	0.53	1.03	0.18	0.58	0.34	0.43	0.77
1230	0.87	0.59	0.75	0.24	0.58	0.21	0.48	0.87
1300	0.85	0.58	0.79	0.24	0.65	0.25	0.64	0.87
1330	0.88	0.62	0.72	0.31	0.78	0.24	0.70	0.77
1400	1.41	0.63	0.47	0.22	0.74	0.28	0.65	0.66
1430	1.64	0.57	0.49	0.23	0.82	0.25	0.79	0.56
1500	0.57	0.51	0.52	0.26	0.83	<0.15	0.84	0.53
1530	1.09	0.50	0.74	0.22	0.80	0.15	0.92	0.69
1600	0.89	0.49	0.76	0.22	0.67	0.21	1.07	0.62
1630	0.47	0.49	0.64	0.23	0.65	0.18	1.17	0.78
1700	0.38	0.52	0.52	0.18	0.66	0.21	1.27	0.93
1730	0.36	0.32	0.46	0.21	0.70	0.27	1.31	0.99
1800	0.27	0.40	0.49	0.15	0.61	0.35	0.90	0.87
1830	0.42	0.39	0.37	0.20	0.50	0.31	0.82	0.64
1900	0.59	0.32	0.31	<0.15	0.54	0.15	0.73	0.57
1930	0.51	0.32	0.27	0.20	0.69	0.17	0.76	0.61
2000	0.85	0.31	0.26	0.22	0.61	0.22	0.89	0.56
2030	1.23	0.29	0.30	0.30	0.51	0.18	0.87	0.62
2100	1.29	0.24	0.34	0.32	0.51	0.19	0.77	0.45
2130	1.09	<0.15	0.31	0.28	0.55	0.16	0.68	0.41
2200	0.84	<0.15	0.30	0.21	0.65	0.15	0.79	0.37
2230	0.95	0.17	0.39	0.23	0.60	0.18	0.83	0.33
2300	0.79	0.17	0.21	0.25	0.73	0.15	0.54	0.37
2330	0.76	0.16	0.15	0.20	0.37	<0.15	0.59	0.33
2400	0.77	<0.15	0.15	0.23	0.25	0.29	0.56	0.31

continued...

Table 21. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.33	<0.15	<0.15	0.39	<0.15	0.56	0.32	0.31
0100	0.58	<0.15	<0.15	0.41	0.15	0.54	0.47	0.32
0130	0.71	<0.15	<0.15	0.33	<0.15	0.54	0.53	0.34
0200	0.66	<0.15	<0.15	0.30	<0.15	0.54	0.25	0.31
0230	0.53	<0.15	<0.15	0.37	<0.15	0.51	0.40	0.29
0300	0.52	<0.15	<0.15	0.37	0.15	0.51	0.32	0.30
0330	0.49	<0.15	<0.15	0.35	<0.15	0.48	0.35	0.29
0400	0.48	<0.15	<0.15	0.32	<0.15	0.48	0.47	0.31
0430	0.45	<0.15	<0.15	0.29	<0.15	0.49	0.38	0.33
0500	0.40	<0.15	<0.15	0.28	<0.15	0.49	0.44	0.29
0530	0.34	<0.15	<0.15	0.44	0.17	0.48	0.21	0.30
0600	0.33	<0.15	<0.15	0.26	<0.15	0.42	0.19	0.28
0630	0.27	<0.15	<0.15	0.43	<0.15	0.46	0.34	0.24
0700	0.35	<0.15	<0.15	0.22	0.16	0.45	0.29	0.29
0730	0.24	<0.15	<0.15	0.31	0.16	0.50	0.37	0.35
0800	0.19	<0.15	<0.15	0.32	0.19	0.58	0.62	0.35
0830	0.21	<0.15	<0.15	0.29	0.16	0.58	0.69	0.46
0900	0.24	<0.15	<0.15	0.29	0.19	0.80	4.93	0.52
0930	0.20	0.17	<0.15	0.30	<0.15	1.01	7.51	0.62
1000	0.23	<0.15	0.21	0.29	0.15	1.02	3.04	0.80
1030	0.26	0.23	0.19	0.22	0.16	1.18	2.17	0.92
1100	0.18	0.22	0.30	0.15	<0.15	1.73	1.78	0.95
1130	0.22	0.20	0.30	0.23	0.16	1.79	2.98	0.91
1200	0.23	0.17	0.38	0.26	0.21	1.63	2.77	0.68
1230	0.23	0.18	0.52	0.32	0.29	2.26	1.10	
1300	0.19	0.15	0.54	0.43	0.34	1.58	0.65	1.00
1330	0.27	<0.15	0.40	0.30	0.40	1.03	0.70	1.14
1400	0.29	0.17	0.43	0.20	0.53	1.03	0.48	3.30
1430	0.23	<0.15	0.47	0.24	0.65	1.07	0.56	1.92
1500	0.28	<0.15	0.48	0.25	0.71	1.17	0.73	1.75
1530	0.31	<0.15	0.42	0.26	0.70	1.36	0.75	1.71
1600	0.33	<0.15	0.39	<0.15	0.64	1.42	0.82	1.59
1630	0.32	0.15	0.43	0.19	0.58	1.37	0.76	1.62
1700	0.27	<0.15	0.51	0.21	0.61	1.14	0.69	1.45
1730	0.21	<0.15	0.51	0.21	0.55	0.94	0.44	1.43
1800	0.23	<0.15	0.50	0.17	0.53	0.84	0.94	1.36
1830	0.28	<0.15	0.51	0.19	0.54	0.80	0.45	1.36
1900	0.28	<0.15	0.49	0.19	0.53	0.86	0.45	1.25
1930	0.27	<0.15	0.51	0.17	0.58	0.86	0.49	1.08
2000	0.27	<0.15	0.48	<0.15	0.61	1.25	0.44	1.10
2030	0.31	<0.15	0.45	0.18	0.70	0.72	0.44	0.65
2100	0.28	0.18	0.46	<0.15	0.86	0.58	0.44	0.55
2130	0.24	<0.15	0.42	<0.15	0.62	0.46	0.36	0.46
2200	0.24	<0.15	0.44	<0.15	0.78	0.47	0.35	0.62
2230	0.24	<0.15	0.39	0.16	0.72	0.44	0.36	0.51
2300	0.22	<0.15	0.46	0.18	0.65	0.41	0.34	0.46
2330	0.20	<0.15	0.45	<0.15	0.67	0.33	0.31	0.44
2400	<0.15	<0.15	0.42	<0.15	0.63	0.36	0.33	0.45

continued...

Table 21. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030	0.47	<0.15	0.39			0.41	0.68
0100	0.45	<0.15	0.42			0.26	0.27
0130	0.41	<0.15	0.39			0.47	0.54
0200	0.40	<0.15	0.44			0.42	0.48
0230	0.35	<0.15	0.28			0.32	0.68
0300	0.37	<0.15	0.19			0.50	0.63
0330	0.33	<0.15	0.24			0.42	0.78
0400	0.31	<0.15	0.26			0.49	0.63
0430	0.30	<0.15	0.15			0.39	0.80
0500	0.30		0.27			0.50	0.85
0530	0.29					0.58	1.33
0600	0.31					0.25	0.88
0630	0.35					0.19	0.43
0700	0.35	<0.15				0.24	0.77
0730	0.27					0.38	0.84
0800	0.33					0.58	0.40
0830	0.33					0.82	0.93
0900	0.31					1.30	0.87
0930	0.37					1.00	0.98
1000	0.50	<0.15			1.16	1.87	0.92
1030		1.20			1.20	1.92	0.88
1100	<0.15	1.42			1.01	1.19	1.10
1130	<0.15	1.29			0.85	1.14	0.79
1200	<0.15	1.13			0.94	1.27	0.67
1230	<0.15	0.89			0.98		0.54
1300	<0.15	1.03			0.92		0.57
1330	<0.15	1.11			0.80		0.29
1400	<0.15	1.23			0.56		<0.15
1430	<0.15	1.05			0.65		0.46
1500	<0.15	1.14			0.36		0.69
1530	<0.15	1.03			0.37	4.13	0.62
1600	<0.15	0.90			0.60	1.60	0.64
1630	<0.15	0.97			0.55	1.64	0.85
1700	<0.15	0.92			0.64	1.67	0.78
1730	<0.15	1.00			0.67	1.61	0.58
1800	<0.15	1.00			0.65	2.10	0.45
1830	<0.15	1.08			1.28	2.23	0.52
1900	<0.15	1.03			1.03	2.30	0.50
1930	<0.15	1.05			1.09	1.84	0.58
2000	<0.15	0.92			1.08	1.58	0.78
2030	<0.15	0.88			1.15	1.58	0.59
2100	<0.15	0.91			0.67	1.58	0.53
2130	<0.15	1.11			0.66	1.58	0.54
2200	<0.15	0.87			0.47	0.94	0.76
2230	<0.15	0.82			0.35	0.70	0.72
2300	<0.15	0.60			0.40	0.56	0.59
2330	<0.15	0.54			0.44	0.71	0.71
2400	<0.15	0.47			0.32	0.61	0.75

Table 22. PAN concentrations in downtown Edmonton, September 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030		0.24					0.24	0.18
0100		0.15					0.32	0.20
0130	0.60	<0.15					0.34	<0.15
0200	0.66	<0.15					0.34	<0.15
0230	0.61	<0.15					0.23	0.19
0300	0.62	0.20					0.32	<0.15
0330	0.43	0.19					0.20	<0.15
0400	0.17	0.15					0.26	<0.15
0430	0.45	<0.15					0.24	0.16
0500	0.64	<0.15					0.32	<0.15
0530	0.39	<0.15					0.22	<0.15
0600	0.25	<0.15					0.23	<0.15
0630	0.29	<0.15					<0.15	<0.15
0700	0.43						<0.15	<0.15
0730	0.15						<0.15	<0.15
0800	0.51						<0.15	<0.15
0830	0.59						0.21	0.21
0900	0.81						<0.15	0.28
0930	0.87						<0.15	0.27
1000	0.96						<0.15	0.27
1030	1.12						<0.15	0.25
1100	0.99						<0.15	0.24
1130	1.04						<0.15	0.21
1200	1.24						0.24	0.33
1230	1.03						<0.15	0.23
1300	0.96					0.37	<0.15	
1330	0.81					0.40	0.35	0.43
1400	0.52					0.39	0.29	0.32
1430	0.71					0.47	0.37	0.40
1500	0.71					0.33	0.39	0.37
1530	0.54					0.46	0.27	0.19
1600	0.66					0.41	0.28	0.31
1630	0.55					0.44	0.24	0.27
1700	0.46					0.47	0.35	0.44
1730	0.50					0.37	0.35	0.38
1800	0.49					0.44	0.27	0.48
1830	0.44					0.48	0.42	0.39
1900	0.40					0.49	0.18	0.38
1930	0.40					0.41	0.18	0.48
2000	0.34					0.42	0.18	0.36
2030	0.16					0.38	<0.15	0.63
2100	0.24					0.42	<0.15	0.39
2130	0.20					0.35	0.27	0.28
2200	0.15					0.42	<0.15	0.35
2230	0.16					0.31	<0.15	0.34
2300	<0.15					0.23	<0.15	0.34
2330	0.28					0.29	<0.15	0.38
2400	0.19					0.31	<0.15	0.30

continued...

Table 22. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.24				0.25	0.24		
0100	0.27				0.22	0.26		
0130	0.23				0.28	0.28		
0200	0.20				0.24	0.26		
0230	0.22				0.31	0.29		
0300	<0.15				0.29	0.26		
0330	0.18				0.27	0.25		
0400	0.23				0.36	0.24		
0430	0.19				0.35	0.18		
0500	0.19				0.36			
0530	0.16				0.36	0.26		
0600	0.16				0.35	0.21		
0630	0.19				0.39	0.17	0.19	
0700	<0.15				0.35	0.21	0.17	
0730	0.21				0.34	0.20	0.20	<0.15
0800	<0.15				0.31	0.23	0.16	0.20
0830	<0.15				0.20	0.25	0.24	<0.15
0900	<0.15				0.31	<0.15	0.25	0.28
0930	<0.15				0.24	0.29	0.27	0.31
1000	0.18			0.40	0.25	0.30	0.17	0.26
1030	0.20			0.38	0.30	0.29	0.23	0.20
1100	<0.15			0.87	0.27	0.28	0.29	0.20
1130				0.36	0.33	0.26	0.28	0.19
1200	<0.15			0.36	0.23	0.31	0.30	0.21
1230	<0.15			0.31	0.29	0.28	0.34	0.28
1300	<0.15			0.29	0.35	0.39	0.43	0.22
1330	<0.15			0.25	0.29	0.31	0.45	0.16
1400	<0.15			0.33	0.38	0.26	0.52	0.19
1430	<0.15			0.42	0.41		0.49	0.21
1500	<0.15			0.40	0.38		0.47	0.21
1530	<0.15			0.41	0.44		0.50	0.19
1600	<0.15			0.49	0.42		0.39	0.20
1630	<0.15			0.52	0.42		0.34	<0.15
1700	<0.15			0.45	0.38		0.72	<0.15
1730	0.17			0.48	0.41		0.38	<0.15
1800	<0.15			0.43	0.38		0.26	<0.15
1830	<0.15			0.45	0.44		0.32	<0.15
1900	<0.15			0.44	0.38		0.26	<0.15
1930	0.16			0.45	0.40			<0.15
2000	0.24			0.38	0.37			<0.15
2030	0.22			0.32	0.38			<0.15
2100	<0.15			0.33	0.33			<0.15
2130	0.15			0.38	0.28			<0.15
2200	<0.15			0.29	0.32			<0.15
2230	<0.15			0.21	0.26			<0.15
2300	<0.15			0.27	0.23			<0.15
2330	<0.15			0.29	0.27			<0.15
2400				0.24	0.29			<0.15

continued...

Table 22. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	<0.15	<0.15	<0.15	<0.15	<0.15	0.15	0.21	0.21
0100	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.25	0.22
0130	<0.15	<0.15	<0.15	0.15	<0.15	<0.15	0.22	0.16
0200	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.22	0.24
0230	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.19	0.19
0300	<0.15	<0.15	<0.15	0.15	<0.15	<0.15	0.27	0.23
0330	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.25	0.18
0400	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.25	0.23
0430	<0.15	<0.15	<0.15	0.16	<0.15	<0.15	0.22	0.20
0500	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.18	0.21
0530	<0.15	<0.15	<0.15	0.15	<0.15	<0.15	0.21	0.27
0600	<0.15	<0.15	<0.15	0.16	<0.15	<0.15	0.20	0.27
0630	<0.15	<0.15	0.17	<0.15	<0.15	<0.15	<0.15	0.29
0700	<0.15	<0.15	0.20	<0.15	<0.15	<0.15	0.15	0.25
0730	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	0.29
0800	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.33
0830	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.30
0900	<0.15	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	0.33
0930	<0.15	<0.15	<0.15	0.16	<0.15	<0.15	0.15	0.66
1000	<0.15	<0.15	0.16	0.17	<0.15	<0.15	0.18	0.82
1030	<0.15	<0.15	<0.15	0.18	0.18	<0.15	0.25	0.36
1100	<0.15	<0.15	0.15	0.22	0.16	0.16	0.26	0.34
1130	<0.15	<0.15	0.17	0.21	0.16	0.20	0.25	0.30
1200	<0.15	<0.15	0.23	0.22	0.16	0.20	0.20	0.41
1230	<0.15	<0.15	0.23	0.24	<0.15	0.20	0.22	0.46
1300	<0.15	<0.15	0.26	0.23	0.23	0.22	0.25	0.47
1330	<0.15	<0.15	0.29	0.18		0.33	0.20	0.61
1400	<0.15	<0.15	0.25	<0.15	0.21	0.29	0.22	0.65
1430	<0.15	<0.15	0.23	0.20	0.27	0.22	0.24	0.60
1500	<0.15	<0.15	0.16	<0.15	0.21	0.29	0.17	0.73
1530	<0.15	<0.15	<0.15	0.21	0.24	0.36	0.26	0.74
1600	<0.15	<0.15	0.16	0.24	0.24	0.34	0.38	0.72
1630	<0.15	<0.15	<0.15	0.24	0.25	0.35	0.37	0.74
1700	<0.15	<0.15	<0.15	0.25	0.25	0.33	0.41	0.81
1730	<0.15	<0.15	<0.15	0.18	0.24	0.32	0.43	1.00
1800	<0.15	<0.15	0.15	0.23	0.35	0.37	0.44	0.81
1830	<0.15	<0.15	0.17	0.20	0.30	0.40	0.42	0.70
1900	<0.15	<0.15	<0.15	0.17	0.32	0.26	0.39	0.66
1930	<0.15	<0.15	<0.15	0.25	0.31	0.31	0.37	0.67
2000	<0.15	<0.15	0.18	0.20	0.25	0.31	0.28	0.67
2030	<0.15	<0.15	0.19	0.19	0.26	0.30	0.24	0.62
2100	<0.15	<0.15	0.16	0.17	0.27	0.33	0.18	0.56
2130	<0.15	<0.15	0.15	<0.15	0.26	0.31	0.21	0.58
2200	<0.15	<0.15	0.19	<0.15	0.25	0.21	0.18	0.52
2230	<0.15	<0.15	<0.15	0.15	0.27	0.18	0.20	0.44
2300	<0.15	<0.15	<0.15	<0.15	0.21	0.21	0.15	0.49
2330	<0.15	<0.15	0.15	<0.15	<0.15	0.19	0.18	0.54
2400	<0.15	<0.15	<0.15	<0.15	<0.15	0.23	0.19	0.58

continued...

Table 22. Concluded.

Day	25	26	27	28	29	30
Time						
0030	0.66	<0.15	0.22	<0.15	0.37	
0100	0.63	0.15	<0.15	0.15	0.32	
0130	0.58	<0.15	0.15	<0.15	0.30	
0200	0.46	<0.15	<0.15	<0.15	0.31	
0230	0.44	<0.15	<0.15	<0.15	0.27	
0300	0.59	<0.15	0.23	<0.15	0.23	
0330	0.58	<0.15	<0.15	<0.15	0.33	
0400	0.56	<0.15	0.15	0.16	0.32	
0430	0.59	<0.15	<0.15	<0.15	0.28	
0500	0.48	<0.15	0.17	<0.15	0.25	
0530	0.57	<0.15	<0.15	<0.15	0.33	
0600	0.48	<0.15	<0.15	<0.15	0.31	
0630	0.49	<0.15	0.20	<0.15	0.33	
0700	0.51	<0.15	0.19	0.22	0.33	
0730	0.43	0.16	<0.15	<0.15	0.28	
0800	0.47	<0.15	<0.15	0.16	0.33	
0830	0.47	0.25	<0.15	0.15	0.34	
0900	0.43	0.33	<0.15	<0.15	0.24	
0930	0.48	0.34		<0.15	0.33	
1000	0.45	0.34	<0.15	<0.15	0.26	
1030	0.46	0.35	<0.15	0.15	0.25	
1100	0.41	0.33	<0.15	<0.15	0.33	
1130	0.41	0.44	<0.15	0.16	0.48	
1200	0.38	0.48	<0.15	0.25	0.40	
1230	0.47	0.36	<0.15	0.24	0.48	
1300	0.37	0.42	<0.15	0.17		
1330	0.50	0.56	0.15	<0.15		
1400	0.52	0.59	<0.15	0.20		
1430	0.56	0.58	<0.15	0.21		
1500	0.56	0.62	<0.15	0.16		
1530	0.64	0.47	0.15	0.19		
1600	0.65	0.54	0.19	0.23		
1630	0.64	0.65	<0.15	0.23		
1700	0.59	0.80	<0.15	0.20		
1730	0.53	0.84	<0.15	0.17		
1800	0.47	0.88	<0.15	0.26		
1830	0.39	0.83	0.19	0.23		
1900	0.40	0.76	<0.15	0.26		
1930	0.38	0.59	<0.15	0.25		
2000	0.36	0.56	<0.15	0.31		
2030	0.32	0.44	<0.15	0.32		
2100	0.29	0.39	<0.15	0.29		
2130	0.29	0.36		0.29		
2200	0.24	0.34	<0.15	0.30		
2230	0.22	0.24	<0.15	0.30		
2300	0.20	0.23	<0.15	0.30		
2330	0.20	<0.15	<0.15	0.29		
2400	0.15	0.19	<0.15	0.31		

Table 23. PAN concentrations in downtown Edmonton, October 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030				0.24	<0.15		0.16	0.26
0100				<0.15	<0.15		0.18	0.31
0130				<0.15	<0.15		0.17	0.35
0200				0.22	<0.15		<0.15	0.35
0230				0.22	<0.15		<0.15	0.34
0300				<0.15	<0.15		<0.15	0.28
0330				<0.15	<0.15		<0.15	0.32
0400				<0.15	<0.15		<0.15	0.39
0430				0.22	<0.15		<0.15	0.37
0500				<0.15	<0.15		<0.15	0.39
0530				<0.15	<0.15		<0.15	0.25
0600				<0.15	<0.15		<0.15	0.18
0630				<0.15	<0.15		<0.15	0.47
0700				0.16	<0.15		<0.15	0.43
0730				<0.15	<0.15		<0.15	0.47
0800				<0.15	<0.15	<0.15	<0.15	0.55
0830				<0.15	<0.15	<0.15	<0.15	0.60
0900				<0.15	<0.15	<0.15	0.17	0.65
0930				<0.15	<0.15	<0.15	<0.15	0.76
1000				0.15	<0.15	<0.15	0.15	0.66
1030				<0.15	<0.15	0.16	0.15	0.57
1100			0.22	<0.15	<0.15	0.25	0.17	0.57
1130			0.22	<0.15	<0.15	0.28	<0.15	0.51
1200			0.21	<0.15	<0.15	0.31	0.18	0.48
1230			0.23	<0.15	<0.15	0.36	0.18	0.41
1300			0.34	<0.15	<0.15	0.34	0.21	0.39
1330			0.28	<0.15	<0.15	0.29	0.17	0.52
1400			0.27	<0.15	<0.15	0.39	0.20	0.52
1430			0.24	<0.15		0.35	0.17	0.49
1500			0.25	<0.15		0.39	0.18	0.47
1530			0.26	<0.15		0.44	0.22	0.42
1600			0.20	0.16		0.38	0.20	0.46
1630			0.19	<0.15		0.33	0.17	0.47
1700			0.18	<0.15		0.24	0.23	0.71
1730			0.18	<0.15		0.31	0.24	0.56
1800			0.19	<0.15		0.23	0.28	0.60
1830			0.18	<0.15		0.25	0.22	0.51
1900			0.27	<0.15		0.24	0.23	0.43
1930			0.24	<0.15		0.27	0.24	0.45
2000			0.20	<0.15		0.24	0.16	0.44
2030			0.24	<0.15		0.23	0.26	0.33
2100			0.40	<0.15		0.23	0.29	0.40
2130			0.31	<0.15		0.24	0.31	0.31
2200			0.29	<0.15		0.24	0.29	0.47
2230			0.23	<0.15		0.18	0.30	0.55
2300			<0.15	<0.15		0.19	0.33	0.57
2330			<0.15	<0.15		0.18	0.29	0.63
2400			<0.15	<0.15		<0.15	0.31	0.62

continued...

Table 23. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.56			<0.15	0.41	0.31	<0.15	<0.15
0100	0.50			<0.15	0.28	0.34	<0.15	<0.15
0130	0.42			0.15	0.35	0.36	<0.15	<0.15
0200	0.47			<0.15	0.33	0.38	<0.15	<0.15
0230	0.50			<0.15	0.33	0.42	<0.15	<0.15
0300	0.45			<0.15	0.35	0.37	<0.15	<0.15
0330	0.44			<0.15	0.36	0.37	<0.15	<0.15
0400	0.45			<0.15	0.31	0.35	<0.15	<0.15
0430	0.46			<0.15	0.34	0.37	<0.15	<0.15
0500	0.47			<0.15	0.26	0.32	<0.15	<0.15
0530	0.51			<0.15	0.30	0.29	<0.15	<0.15
0600	0.47		0.17	0.19	0.22	0.37	<0.15	<0.15
0630	0.43		0.86	0.15	0.30	0.36	<0.15	<0.15
0700	0.40		0.17	<0.15	0.27	0.30	<0.15	<0.15
0730	0.50		<0.15	<0.15	0.16	0.31	<0.15	<0.15
0800	0.48		<0.15	<0.15	0.17	0.35	<0.15	<0.15
0830	0.42		<0.15	0.17	0.23	0.43	<0.15	<0.15
0900	0.44		0.15	<0.15	<0.15	0.31	<0.15	
0930	0.40		<0.15	0.20	0.26	0.34	<0.15	
1000	0.48		<0.15	0.19	0.32	0.41	<0.15	
1030	0.41		<0.15	0.23	0.43	0.46	<0.15	
1100	0.27		<0.15	<0.15	0.42	0.53	<0.15	
1130	0.28		<0.15	<0.15	0.67	0.45	<0.15	
1200	0.24		<0.15	0.16	0.75	0.48	<0.15	
1230	0.27		<0.15	0.20	0.73	0.34	<0.15	
1300			0.15	0.18	0.68	0.38	<0.15	
1330			<0.15	0.16	0.82	0.37	<0.15	
1400			0.15	0.19	0.84	0.44	<0.15	
1430			<0.15	0.21	0.70	0.50	<0.15	
1500			<0.15	0.17	0.82	0.43	<0.15	
1530			<0.15	0.33	0.75	0.32	<0.15	
1600			<0.15	0.27	0.66	<0.15	<0.15	
1630			0.16	0.61	0.59	<0.15	<0.15	
1700			<0.15	0.46	0.49	<0.15	<0.15	
1730			<0.15	0.70	0.50	<0.15	<0.15	
1800			<0.15	0.51	0.40	<0.15	<0.15	
1830			<0.15	0.42	0.37	<0.15	<0.15	
1900			0.16	0.28	0.52	<0.15	<0.15	
1930			0.15	0.40	0.62	<0.15	<0.15	
2000			<0.15	0.38	0.46	<0.15	<0.15	
2030			0.15	0.43	0.55	<0.15	<0.15	
2100			<0.15	0.31	0.34	<0.15	<0.15	
2130			<0.15	0.33	0.28	<0.15	<0.15	
2200			<0.15	0.38	0.26	<0.15	<0.15	
2230			<0.15	0.38	0.32	<0.15	<0.15	
2300			<0.15	0.45	0.34	<0.15	<0.15	
2330			<0.15	0.30	0.36	<0.15	<0.15	
2400			<0.15	0.28	0.34	<0.15	<0.15	

continued...

Table 23. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030		0.22	0.42	0.28	0.24	0.29		
0100		0.23	0.42	0.27	0.25	0.28		
0130		0.23	0.36	0.28	0.25	0.19		
0200		<0.15	0.37	0.31	0.19	0.19		
0230			0.33	0.28	0.26	0.23		
0300			0.32	0.34	0.22	0.20		
0330			0.31	0.28	0.18	0.20		
0400			0.31	0.29	0.16	0.16		
0430			0.28	<0.15	0.20	0.22		
0500			0.29	<0.15	0.20	0.18		
0530			0.25	<0.15	<0.15	0.19		
0600			0.24	<0.15	0.15	0.20		
0630			0.23	<0.15	<0.15	0.17		
0700		0.18	0.21	<0.15	<0.15	0.17		
0730		0.18	0.18	0.24	0.16	0.19		
0800		0.17	0.18	<0.15	0.18	0.18		
0830		0.16	0.17	<0.15	0.22	0.15		
0900	0.18	0.20	0.19	0.62	0.28	0.25		
0930	0.15		0.19	0.57	0.33	0.18		
1000	0.17		0.15	0.47	0.40	0.18		
1030	0.18	0.33	0.27	0.71	0.41	0.22		
1100	0.21	0.36	0.30	1.18	0.55	0.19		
1130	0.21	0.39	0.31	1.08	0.57	0.22		
1200	0.22	0.39	0.28	1.23	0.57	0.26		
1230	0.34		0.39	0.92	0.60	0.33		
1300	0.33		0.52	0.73	0.56	0.26		
1330	0.39		0.38	0.56	0.53	0.27		
1400	0.42		0.28	0.52	0.43	0.24		
1430	0.40		0.31	0.34	0.39	0.32		
1500	0.42	0.52	0.35	0.31	0.47	0.35		
1530	0.43	0.64	0.49	0.26	0.44	0.26		
1600	0.41	0.50	0.43	0.23	0.41	0.37		
1630	0.40	0.46	0.42	0.30	0.46	0.33		
1700	0.46	0.53	0.40	0.27	0.50	0.31		
1730	0.45	0.54	0.32	0.40	0.42	0.31		
1800	0.51	0.53	0.34	0.36	0.44	0.34		
1830	0.43	0.72	0.29	0.37	0.50	0.33		
1900	0.56	0.65	0.32	0.34	0.49			
1930	0.57	0.45	0.27	0.42	0.44			
2000	0.53	0.44	0.15	0.42	0.46			
2030	0.43	0.46	0.27	0.49	0.39			
2100	0.38	0.47	0.31	0.44	0.44			
2130	0.32	0.45	0.36	0.43	0.36			
2200	0.27	0.38	0.32	0.43	0.34			
2230	0.25	0.45	0.47	0.33	0.38			
2300	0.24	0.53	0.31	0.37	0.30			
2330	0.25	0.44	0.23	0.30	0.27			
2400	0.22	0.42	0.29	0.30	0.38			

continued...

Table 23. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030			<0.15	<0.15	0.29	0.36	0.20
0100			<0.15	<0.15	0.27	0.35	0.23
0130			<0.15	<0.15	0.28	0.31	0.24
0200			<0.15	<0.15	0.25	0.29	0.22
0230			<0.15	0.15	0.34	0.30	0.25
0300			<0.15	<0.15	0.29	0.28	0.27
0330			<0.15	<0.15	0.21	0.26	0.26
0400			<0.15	<0.15	0.26	0.23	0.26
0430			<0.15	<0.15	0.26	0.18	0.30
0500			<0.15	<0.15	0.25	0.18	0.26
0530			<0.15	<0.15	0.18	0.16	0.26
0600			<0.15	<0.15	0.16	<0.15	0.24
0630			<0.15	<0.15	0.16	<0.15	0.21
0700			<0.15	<0.15	<0.15	<0.15	0.20
0730			<0.15	<0.15	<0.15	<0.15	0.26
0800			<0.15	<0.15	<0.15	<0.15	0.19
0830			<0.15	0.15	<0.15	<0.15	0.21
0900			<0.15	0.18	<0.15	<0.15	0.22
0930			<0.15	0.17	0.17	<0.15	0.25
1000			<0.15	0.16	0.20	<0.15	0.21
1030			<0.15	0.19	0.16	<0.15	0.32
1100			<0.15	0.15	0.26	0.16	0.34
1130			<0.15	0.19	0.33	0.23	0.36
1200			<0.15	0.19	0.44	0.15	0.38
1230		<0.15	<0.15	0.19	0.50	0.21	0.45
1300		0.18	<0.15	0.21	0.63	0.24	0.39
1330		0.15	<0.15	0.24	0.76	0.24	0.58
1400		<0.15	0.15	0.27	0.85	0.26	0.61
1430		<0.15	<0.15	0.25	0.96	0.37	0.56
1500		0.16	0.16	0.32	0.85	0.43	0.44
1530		0.19	0.16	0.31	0.73	0.40	0.39
1600		0.15	<0.15	0.34	0.69	0.38	0.38
1630		0.16	<0.15	0.32	0.76	0.36	0.34
1700		<0.15	<0.15	0.34	0.71	0.31	0.29
1730		0.15	<0.15	0.33	0.75	0.30	0.26
1800		<0.15	<0.15	0.31	0.69	0.32	0.23
1830		<0.15	<0.15	0.31	0.67	0.29	0.20
1900		<0.15	<0.15	0.26	0.75	0.33	0.19
1930		<0.15	<0.15	0.29	0.67	0.26	0.17
2000		<0.15	<0.15	0.33	0.62	0.34	<0.15
2030		<0.15	<0.15	0.29	0.58	0.36	<0.15
2100		0.16	<0.15	0.27	0.56	0.21	<0.15
2130		<0.15	<0.15	0.27	0.55	0.22	<0.15
2200		<0.15	<0.15	0.27	0.54	0.25	<0.15
2230		<0.15	<0.15	0.27	0.46	0.27	<0.15
2300		<0.15	<0.15	0.24	0.45	0.22	<0.15
2330		<0.15	<0.15	0.30	0.43	0.24	<0.15
2400		<0.15	<0.15	0.26	0.44	0.23	<0.15

Table 24. PAN concentrations in downtown Edmonton, November 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	<0.15	<0.15	0.18		0.15	0.27		<0.15
0100	<0.15	<0.15	0.16		<0.15	0.19		<0.15
0130	<0.15	<0.15	0.16		<0.15	0.20		
0200	<0.15	<0.15	0.17		0.16	0.20		
0230	<0.15	<0.15	0.19		<0.15	0.20		
0300	<0.15	<0.15	0.17		<0.15	0.19		
0330	<0.15	<0.15	0.18		<0.15	0.19		
0400	<0.15	<0.15	<0.15		<0.15	0.19		
0430	<0.15	<0.15	<0.15		<0.15	0.18		
0500	<0.15	0.15	<0.15		<0.15	0.16		
0530	<0.15	0.17	0.16		<0.15	0.20		
0600	<0.15	<0.15	0.16		<0.15	0.19		
0630	<0.15	<0.15	<0.15		<0.15	0.18		
0700	<0.15	<0.15	<0.15		<0.15	<0.15		
0730	<0.15	<0.15	<0.15		<0.15	0.15		
0800	<0.15	<0.15	<0.15		0.17	<0.15		
0830	<0.15	<0.15	<0.15		0.32	<0.15		
0900	<0.15	<0.15	<0.15	<0.15	<0.15	0.17		
0930	<0.15	<0.15	<0.15	0.15	<0.15	0.18		
1000	<0.15	<0.15	<0.15	0.19	<0.15	0.19		
1030	<0.15	<0.15	<0.15	0.21	0.15	0.21		
1100	<0.15	<0.15	<0.15	0.26	0.17	0.23		
1130	<0.15	<0.15	<0.15	0.20	0.25	0.30		
1200	<0.15	0.16	<0.15	0.17	0.19	0.33		
1230	<0.15	0.19	<0.15	0.18	0.18	0.33		
1300	<0.15	0.20	<0.15	0.19	0.31	0.43		
1330	<0.15	0.21	<0.15	0.23	0.20	0.36		
1400	<0.15	0.22	<0.15	0.16	0.20	0.38	<0.15	
1430	<0.15	0.22	<0.15	<0.15	0.21	0.48	<0.15	
1500	<0.15	0.24		<0.15	0.19	0.34	<0.15	
1530	<0.15	0.22		<0.15	<0.15	0.26	<0.15	
1600	<0.15	0.23		0.15	0.22	0.29	0.16	
1630	<0.15	0.23		0.17	0.40	0.26	<0.15	
1700	<0.15	0.25		0.17	0.39	0.26	<0.15	
1730	<0.15	0.24		0.15	0.37	0.15	0.18	
1800	<0.15	0.25		<0.15	0.34	0.15	0.16	
1830	<0.15	0.25		0.16	0.29	0.17	0.17	
1900	<0.15	0.26		0.17	0.33		0.21	
1930	<0.15	0.25		<0.15	0.26		0.24	
2000	<0.15	0.28		<0.15	0.25		0.22	
2030	<0.15	0.26		0.18	0.25		0.25	
2100	<0.15	0.25		<0.15	0.28		0.17	
2130	<0.15	0.23		<0.15	0.21		0.15	
2200	<0.15	0.22		<0.15	0.19		<0.15	
2230	<0.15	0.20		<0.15	0.18		<0.15	
2300	<0.15	0.20		<0.15	0.17		<0.15	
2330	<0.15	0.16		<0.15	0.19		<0.15	
2400	<0.15	0.17		<0.15	0.17		<0.15	

continued...

Table 24. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030		<0.15	<0.15	<0.15	0.18	0.26	0.22	<0.15
0100		<0.15	<0.15	<0.15	0.17	0.24		<0.15
0130		<0.15	<0.15	<0.15	0.16	0.24		<0.15
0200		<0.15	<0.15	<0.15	0.16	0.24		<0.15
0230		<0.15	<0.15	<0.15	0.16	0.23		<0.15
0300		<0.15	<0.15	<0.15	0.15	0.23		<0.15
0330		<0.15	<0.15	<0.15	0.17	0.24		<0.15
0400		<0.15	<0.15	<0.15	0.17	0.21		<0.15
0430		<0.15	<0.15	<0.15	0.18	0.23		<0.15
0500		<0.15	<0.15	<0.15	0.15	0.17		<0.15
0530		<0.15	<0.15	<0.15	0.15	0.19		<0.15
0600		<0.15	<0.15	<0.15	0.18	0.21		<0.15
0630		<0.15	<0.15	<0.15	0.17	0.18		<0.15
0700		<0.15	<0.15	<0.15	0.18	0.15		<0.15
0730		<0.15	<0.15	<0.15	0.20	<0.15		<0.15
0800		<0.15	0.15	<0.15	0.20	<0.15		<0.15
0830		<0.15	0.15	<0.15	0.22	0.17		<0.15
0900		<0.15	<0.15	0.16	0.25	0.16		<0.15
0930		<0.15	<0.15	0.17	0.29	0.15		<0.15
1000		<0.15	0.15	0.21	0.29	0.17		<0.15
1030		<0.15	<0.15	0.18	0.31	0.20		<0.15
1100		<0.15	0.15	<0.15	0.29	0.27		<0.15
1130		<0.15	0.15	0.16	0.30	0.29	<0.15	<0.15
1200		<0.15	0.16	0.18	0.30	0.35	<0.15	<0.15
1230		<0.15	0.16	0.22	0.29	0.40	<0.15	<0.15
1300		<0.15	0.15	0.24	0.29	0.30	<0.15	<0.15
1330	0.34	<0.15	0.16	0.53	0.27	0.43	<0.15	<0.15
1400	<0.15	<0.15	0.17	0.54	0.25	0.57	<0.15	<0.15
1430	<0.15	<0.15	0.16	0.65	0.29	0.65	<0.15	<0.15
1500	<0.15	<0.15	0.17	0.54	0.28	0.62	0.15	<0.15
1530	<0.15	<0.15	0.17	0.70	0.32	0.54	<0.15	<0.15
1600	<0.15	<0.15	0.18	0.60	0.34	0.48	<0.15	<0.15
1630	<0.15	<0.15	0.17	0.58	0.36	0.32	<0.15	<0.15
1700	<0.15	<0.15	0.17	0.56	0.33	0.30	<0.15	<0.15
1730	<0.15	<0.15	0.17	0.54	0.34	0.17	<0.15	<0.15
1800	<0.15	<0.15	0.16	0.53	0.36	0.19	<0.15	<0.15
1830	<0.15	<0.15	0.15	0.52	0.37	0.22	<0.15	<0.15
1900	<0.15	<0.15	0.16	0.61	0.34	0.22	<0.15	<0.15
1930	<0.15	<0.15	0.16	0.60	0.35	0.18	<0.15	<0.15
2000	<0.15	<0.15	0.15	0.57	0.31	0.22	<0.15	<0.15
2030	<0.15	<0.15	0.15	0.54	0.31	0.18	<0.15	<0.15
2100	<0.15	<0.15	0.15	0.39	0.30	0.22	<0.15	<0.15
2130	<0.15	<0.15	0.16	0.24	0.29	0.23	<0.15	<0.15
2200	<0.15	<0.15	0.17	0.21	0.28	0.22	<0.15	<0.15
2230	<0.15	<0.15	0.17	0.22	0.26	0.26	<0.15	<0.15
2300	<0.15	<0.15	<0.15	0.18	0.26	0.25	<0.15	<0.15
2330	<0.15	<0.15	0.16	0.17	0.25	0.26	<0.15	<0.15
2400	<0.15	<0.15	<0.15	0.18	0.24	0.27	<0.15	<0.15

continued...

Table 24. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030		0.20	<0.15			<0.15	<0.15	<0.15
0100		0.16				<0.15	<0.15	0.15
0130		<0.15				<0.15	<0.15	0.18
0200		<0.15				<0.15	<0.15	<0.15
0230		<0.15				<0.15	<0.15	0.19
0300		<0.15				<0.15	<0.15	0.15
0330		<0.15				<0.15	<0.15	0.17
0400		<0.15				<0.15	<0.15	0.16
0430		<0.15				<0.15	<0.15	0.18
0500		0.17				<0.15	<0.15	<0.15
0530		<0.15				<0.15	<0.15	0.16
0600		<0.15				<0.15	<0.15	0.18
0630		0.16				<0.15	0.16	<0.15
0700		<0.15				<0.15	0.17	0.16
0730		<0.15				<0.15	<0.15	<0.15
0800		<0.15				<0.15	<0.15	0.15
0830		<0.15				<0.15	0.15	<0.15
0900		<0.15				<0.15	0.16	<0.15
0930		<0.15				<0.15	0.15	<0.15
1000		<0.15				<0.15	0.15	0.15
1030		<0.15			<0.15	<0.15	0.15	0.15
1100		<0.15			<0.15	<0.15	<0.15	0.19
1130	<0.15	<0.15			<0.15	<0.15	0.17	0.19
1200	<0.15	<0.15			<0.15	<0.15	0.16	0.20
1230	<0.15	<0.15			<0.15	<0.15	0.16	0.18
1300	<0.15	<0.15			<0.15	<0.15	0.15	0.20
1330	<0.15	<0.15			<0.15	<0.15	0.16	0.20
1400		<0.15			<0.15	<0.15	0.16	0.20
1430	<0.15	<0.15			<0.15	<0.15	0.15	0.19
1500	0.15	<0.15			<0.15	<0.15	0.16	0.15
1530	<0.15	<0.15			<0.15	<0.15	0.15	0.15
1600	0.15	<0.15			<0.15	<0.15	0.18	0.18
1630	0.19	<0.15			<0.15	<0.15	0.18	0.18
1700	0.22	<0.15			<0.15	<0.15	0.17	0.18
1730	0.21	<0.15			<0.15	<0.15	0.17	0.16
1800	0.22	<0.15			<0.15	<0.15	0.18	0.17
1830	0.21	<0.15			<0.15	<0.15	0.17	0.19
1900	0.20	<0.15			<0.15	<0.15	0.16	0.16
1930	0.22	<0.15			<0.15	<0.15	0.19	0.16
2000	0.22	<0.15			<0.15	<0.15	0.17	0.18
2030	0.20	<0.15			<0.15	<0.15	0.17	<0.15
2100	0.17	<0.15			<0.15	<0.15	<0.15	0.16
2130	0.16	<0.15			<0.15	<0.15	<0.15	0.16
2200	0.17	<0.15			<0.15	<0.15	<0.15	0.17
2230	0.18	<0.15			<0.15	<0.15	<0.15	0.17
2300	0.21	<0.15			<0.15	<0.15	0.15	<0.15
2330	0.19	<0.15			<0.15	<0.15	0.15	0.15
2400	0.21	<0.15			<0.15	<0.15	0.16	<0.15

continued...

Table 24. Concluded.

Day	25	26	27	28	29	30
Time						
0030	<0.15	0.15			<0.15	0.19
0100	<0.15	<0.15			<0.15	0.15
0130	<0.15	<0.15			<0.15	0.18
0200	<0.15	<0.15			<0.15	<0.15
0230	<0.15	<0.15			<0.15	<0.15
0300	0.17	<0.15			<0.15	<0.15
0330	<0.15	<0.15			<0.15	<0.15
0400	0.16	<0.15			<0.15	<0.15
0430	<0.15	<0.15			<0.15	<0.15
0500	<0.15	0.15			<0.15	0.15
0530	<0.15	0.15			<0.15	<0.15
0600	<0.15	<0.15			<0.15	<0.15
0630	<0.15	0.16			<0.15	<0.15
0700	<0.15	0.17			<0.15	0.15
0730	<0.15	0.19			<0.15	0.17
0800	<0.15	0.18			<0.15	0.17
0830	<0.15	0.18			<0.15	0.18
0900	<0.15	0.19			<0.15	0.17
0930	<0.15	0.17			<0.15	0.15
1000	<0.15	0.18				
1030	<0.15	0.18		<0.15	<0.15	
1100	<0.15	0.18			<0.15	
1130	<0.15	0.20			<0.15	
1200	<0.15	0.20		<0.15	<0.15	
1230	<0.15	0.22		<0.15	<0.15	
1300	<0.15	0.23		<0.15	<0.15	
1330	<0.15	0.24		<0.15	<0.15	
1400	<0.15	0.24		<0.15		
1430	<0.15	0.24		<0.15	<0.15	
1500	0.15	0.24		<0.15		
1530	<0.15	0.24		<0.15	<0.15	0.23
1600	<0.15	0.25		<0.15		0.23
1630	<0.15	0.25		<0.15	<0.15	0.22
1700	<0.15	0.26		<0.15	<0.15	0.22
1730	<0.15	0.26		<0.15	<0.15	0.24
1800	<0.15	0.24		<0.15	<0.15	0.25
1830	<0.15	0.25		<0.15	<0.15	0.26
1900	<0.15	0.25		<0.15	<0.15	0.27
1930	<0.15	0.22		<0.15	0.19	0.24
2000	<0.15	0.23		<0.15	0.18	0.27
2030	<0.15	0.22		<0.15	0.15	0.28
2100	<0.15	0.22		<0.15	<0.15	0.28
2130	<0.15	0.21		<0.15	<0.15	0.22
2200	<0.15			<0.15	0.19	0.22
2230	<0.15			<0.15	0.17	0.18
2300	<0.15			<0.15	0.20	0.18
2330	<0.15			<0.15	0.19	0.17
2400	0.16			<0.15	0.18	0.17

Table 25. PAN concentrations in downtown Edmonton, December 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	0.16	0.19	<0.15	<0.15	<0.15	<0.15		<0.15
0100	<0.15	0.18	<0.15	<0.15	<0.15	<0.15		<0.15
0130	<0.15	0.21	<0.15	<0.15	<0.15	<0.15		<0.15
0200	<0.15	0.19	<0.15	<0.15	<0.15	<0.15		<0.15
0230	<0.15	0.37	<0.15	<0.15	<0.15	<0.15		<0.15
0300	<0.15	0.18	<0.15	<0.15	<0.15	<0.15		<0.15
0330	<0.15	0.19	<0.15	<0.15	<0.15	<0.15		<0.15
0400	<0.15	0.20	<0.15	<0.15	<0.15	<0.15		<0.15
0430	<0.15	0.19	<0.15	<0.15	<0.15	<0.15		<0.15
0500	<0.15	0.21	<0.15	<0.15	<0.15	<0.15		0.16
0530	<0.15	0.22	<0.15	<0.15	<0.15	<0.15		<0.15
0600	<0.15	0.21	<0.15	<0.15	<0.15	<0.15		<0.15
0630	<0.15	0.21	<0.15	<0.15	<0.15	<0.15		<0.15
0700	<0.15	0.22	<0.15	<0.15	<0.15	<0.15		0.16
0730	<0.15	0.19	<0.15	<0.15	<0.15	<0.15		0.15
0800	<0.15	0.19	<0.15	<0.15		<0.15		0.18
0830	<0.15		<0.15	<0.15		<0.15		0.16
0900			<0.15	<0.15		<0.15		<0.15
0930	<0.15		<0.15	<0.15		<0.15		0.17
1000	<0.15		<0.15	0.21		<0.15		0.18
1030	0.15		<0.15	0.24	<0.15	<0.15		0.20
1100	0.17		<0.15	0.29	<0.15	<0.15		0.21
1130	<0.15		<0.15	0.30	<0.15	<0.15		0.23
1200	<0.15		<0.15	0.34	<0.15	0.15		0.26
1230	<0.15		<0.15	0.22	<0.15	0.16		0.15
1300			<0.15	0.19	<0.15	<0.15	<0.15	0.23
1330	<0.15		<0.15	0.18	<0.15	<0.15	0.15	0.19
1400	<0.15	0.32	<0.15	0.20	<0.15	<0.15	0.15	0.20
1430	0.18	0.33	<0.15	0.20	<0.15	<0.15	0.15	0.30
1500	0.17	0.31	0.16	0.53	<0.15		<0.15	0.30
1530	0.18	0.25	<0.15	0.24	<0.15		<0.15	0.20
1600	0.19	0.24	<0.15	0.28	0.15		0.15	0.23
1630	0.19	0.24	<0.15	0.34	0.17		0.15	[illegible]
1700	0.17	0.20	0.16	0.34	<0.15		<0.15	[illegible]
1730	<0.15	0.18	<0.15	0.33	<0.15		0.16	0.20
1800	0.16	0.18	<0.15	0.30	<0.15		0.16	0.19
1830	0.19	0.16	<0.15	0.33	<0.15		0.18	0.24
1900	<0.15	0.16	<0.15	0.27	<0.15		0.18	0.19
1930	<0.15	0.15	<0.15	0.28	<0.15		<0.15	0.20
2000	<0.15	<0.15	<0.15	0.24	<0.15		0.17	0.19
2030	0.18	<0.15	<0.15	0.19	<0.15		0.16	0.19
2100	0.19	<0.15	0.15	0.15	<0.15		<0.15	0.19
2130	0.17	<0.15	<0.15	<0.15	<0.15		<0.15	0.18
2200	<0.15	<0.15	<0.15	<0.15	<0.15		0.16	0.17
2230	0.18	0.19	<0.15	<0.15	<0.15		0.15	0.20
2300	0.17	<0.15	<0.15	<0.15	<0.15		0.16	0.18
2330	0.16	0.15	<0.15	<0.15	<0.15		<0.15	0.17
2400	0.17	<0.15	<0.15	<0.15	<0.15		0.17	0.19

continued...

Table 25. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.16	<0.15	0.21	0.24	0.20	<0.15		0.17
0100	0.18	0.16	0.21	0.22	0.21	<0.15		<0.15
0130	0.17	<0.15	0.20	0.23	0.23	<0.15		0.16
0200	0.23	<0.15	0.19	0.23	0.23	<0.15		<0.15
0230	0.20	<0.15	0.20	0.21	0.22	0.15		0.16
0300	0.21	0.15	0.19	0.22	0.23	<0.15		<0.15
0330	0.20	<0.15	0.17	0.21	0.24	0.15		<0.15
0400	0.21	<0.15	0.18	0.22	0.24	0.16		0.15
0430	0.16	<0.15	0.18	0.21	0.26	<0.15		<0.15
0500	0.17	<0.15	0.17	0.21	0.28	<0.15		0.17
0530	0.15	<0.15	0.20	0.20	0.28	<0.15		0.17
0600	0.17	<0.15	0.18	0.21	0.27	0.15		<0.15
0630	0.16	<0.15	0.16	0.22	0.27	0.15		0.16
0700	0.16	0.15	0.17	0.22	0.28	0.16		0.16
0730	0.18	0.16	0.17	0.21	0.26	0.18		<0.15
0800	0.17	<0.15	0.16	0.20	0.25	<0.15		0.15
0830	0.17	0.15	<0.15	0.22	0.25	<0.15		<0.15
0900	<0.15	0.15	0.16	0.22	0.24	<0.15		0.17
0930	<0.15	0.16	0.17	0.26	0.19	0.16		0.17
1000	0.16	0.15	0.20	0.25		<0.15		0.19
1030	0.15	<0.15	0.17	0.22	<0.15	0.17		0.15
1100	0.16	0.17	0.20	0.18	0.15	0.19		0.16
1130	0.15	0.19	0.22	0.26	<0.15	0.28		0.19
1200	0.18	0.18	0.23	0.25	<0.15	0.23		0.15
1230	0.15	0.20	0.25	0.25	<0.15	0.24		0.16
1300	0.18	0.19	0.26	0.27	<0.15	0.22	0.23	0.16
1330	0.16	0.20	0.27	0.27	<0.15	0.23	0.22	0.18
1400	0.17	0.20	0.28	0.25	<0.15	0.23	0.21	0.17
1430	0.15	0.23	0.26	0.27	<0.15	0.24	0.16	0.16
1500	0.18	0.26	0.31	0.27	<0.15	0.22	0.16	0.15
1530	0.15	0.23	0.31	0.22	<0.15		0.20	0.15
1600	0.18	0.24	0.29	0.22	<0.15		0.20	0.16
1630	0.18	0.23	0.30	0.25	<0.15		0.20	0.15
1700	<0.15	0.21	0.32	0.24	<0.15		0.20	0.16
1730	0.15	0.21	0.29	0.22	<0.15		0.24	0.16
1800	0.16	0.20	0.28	0.22	<0.15		0.23	<0.15
1830	<0.15	0.19	0.29	0.23	<0.15		0.20	0.16
1900	<0.15	0.16	0.25	0.22	<0.15		0.20	0.16
1930	<0.15	0.17	0.28	0.18	<0.15		0.21	0.17
2000	<0.15	0.18	0.27	0.17	<0.15		0.15	0.17
2030	<0.15	0.19	0.29	0.18	<0.15		0.20	0.15
2100	0.15	0.17	0.28	0.19	<0.15		0.19	<0.15
2130	<0.15	0.18	0.33	0.21	<0.15		0.18	0.16
2200	<0.15	0.19	0.33	0.18	<0.15		0.17	<0.15
2230	0.15	0.19	0.31	0.19	<0.15		0.17	0.16
2300	<0.15	0.19	0.31	0.19	<0.15		0.18	0.17
2330	<0.15	0.20	0.31	0.20	<0.15		0.17	0.16
2400	0.16	0.19	0.24	0.20	<0.15		<0.15	<0.15

continued...

Table 25. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.19	0.18	0.24	<0.15	<0.15	<0.15	<0.15	<0.15
0100	0.18	0.16	0.22	<0.15	<0.15	<0.15	0.15	<0.15
0130	0.15	0.18	0.22	<0.15	<0.15	<0.15	<0.15	<0.15
0200	0.17	0.17	0.21	<0.15	<0.15	<0.15	<0.15	<0.15
0230	0.16	0.19	0.20	<0.15	<0.15	<0.15	<0.15	<0.15
0300	0.16	0.19	0.21	<0.15	<0.15	<0.15	<0.15	<0.15
0330	0.15	0.18	0.22	<0.15	<0.15	<0.15	<0.15	<0.15
0400	0.17	0.18	0.20	<0.15	<0.15	<0.15	<0.15	<0.15
0430	<0.15	0.19	0.22	<0.15	<0.15	<0.15	<0.15	<0.15
0500	<0.15	0.16	0.21	<0.15	<0.15	<0.15	<0.15	<0.15
0530	0.16	0.17	0.23	<0.15	<0.15	<0.15	<0.15	<0.15
0600	0.15	0.17	0.24	<0.15	<0.15	<0.15	<0.15	<0.15
0630	<0.15	0.17	0.22	<0.15	<0.15	<0.15	<0.15	<0.15
0700	0.15	0.17	0.19	<0.15	<0.15	<0.15	<0.15	<0.15
0730	0.17	0.19	0.21	<0.15	<0.15	<0.15	<0.15	<0.15
0800	<0.15	0.18	0.21	<0.15	<0.15	<0.15	<0.15	<0.15
0830	0.17	0.18	0.21	<0.15	<0.15	<0.15	<0.15	<0.15
0900	0.18	0.19	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
0930	0.16	0.20	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
1000	0.18	0.21	0.19	<0.15	<0.15	<0.15	<0.15	<0.15
1030	0.18	0.22	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
1100	0.18	0.25	0.18	0.15	<0.15	<0.15	0.15	<0.15
1130	0.20	0.20	0.17	0.15	<0.15	<0.15	<0.15	<0.15
1200	0.20	0.23	0.19	0.15	<0.15	<0.15	0.17	<0.15
1230	0.22	0.25	0.18	0.18	<0.15	<0.15	0.16	<0.15
1300	0.20	0.24	0.18	0.19	<0.15	<0.15	0.15	<0.15
1330	0.22	0.24	0.17	0.19	<0.15	<0.15	0.17	<0.15
1400	0.22	0.24	0.17	0.17	<0.15	<0.15	0.15	<0.15
1430	0.23	0.25	0.19	0.17	<0.15	<0.15	0.15	<0.15
1500	0.24	0.25	0.18	0.17	<0.15	<0.15	0.16	<0.15
1530	0.22	0.27	0.18	0.17	<0.15	<0.15	<0.15	<0.15
1600	0.21	0.24	0.19	<0.15	<0.15	<0.15	0.15	<0.15
1630	0.20	0.24	0.17	0.15	<0.15	<0.15	0.16	<0.15
1700	0.18	0.25	0.17	<0.15	<0.15	<0.15	0.17	<0.15
1730	0.16	0.25	0.24	<0.15	<0.15	<0.15	<0.15	<0.15
1800	0.18	0.24	0.16	<0.15	<0.15	<0.15	<0.15	<0.15
1830	0.18	0.23	0.15	<0.15	<0.15	<0.15	<0.15	<0.15
1900	0.19	0.22	0.16	0.15	<0.15	<0.15	<0.15	<0.15
1930	0.17	0.23	0.17	0.15	<0.15	<0.15	0.15	<0.15
2000	0.16	0.23	0.16	<0.15	<0.15	<0.15	0.15	<0.15
2030	0.16	0.22	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
2100	0.16	0.22	0.15	<0.15	<0.15	<0.15	<0.15	<0.15
2130	0.19	0.22	0.15	<0.15	<0.15	<0.15	<0.15	<0.15
2200	0.21	0.22	0.17	<0.15	<0.15	<0.15	0.17	<0.15
2230	0.16	0.21	<0.15	<0.15	<0.15	<0.15	<0.15	0.15
2300	0.21	0.20	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
2330	0.19	0.22	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
2400	0.19	0.23	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15

continued...

Table 25. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030	<0.15	<0.15	<0.15	<0.15	0.15	<0.15	
0100	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0130	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0200	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0230	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0300	<0.15	<0.15	<0.15	<0.15	0.16	<0.15	
0330	<0.15	<0.15	<0.15	<0.15	0.15	<0.15	
0400	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0430	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0500	<0.15	<0.15	<0.15	<0.15	0.15	<0.15	
0530	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0600	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0630	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0700	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0730	<0.15	<0.15	<0.15	<0.15	0.15	<0.15	
0800	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	
0830	<0.15	<0.15	<0.15	<0.15	<0.15		
0900	<0.15	<0.15	<0.15	<0.15	<0.15		
0930	<0.15	<0.15	<0.15	<0.15	<0.15		
1000	<0.15	<0.15	<0.15	<0.15	<0.15		
1030	<0.15	<0.15	<0.15	<0.15	0.15		
1100	<0.15	<0.15	<0.15	0.16	<0.15		
1130	0.17	<0.15	<0.15	<0.15	0.16		
1200	0.17	<0.15	<0.15	0.15	0.16		
1230	0.16	<0.15	<0.15	0.16	0.17		
1300	0.15	<0.15	<0.15	0.16	0.19		
1330	0.20	<0.15	<0.15	0.18	0.18		
1400	0.18	<0.15	<0.15	0.18	0.19		
1430	0.19	<0.15	0.15	0.17	0.20		
1500	0.18	<0.15	0.15	0.20	0.19		
1530	0.16	<0.15	<0.15	0.17	0.18		
1600	0.17	<0.15	<0.15	0.15	0.19		
1630	0.16	<0.15	0.15	0.16	0.17		
1700	<0.15	<0.15	<0.15	0.16	0.18		
1730	0.17	<0.15	<0.15	0.16	0.15		
1800	0.15	<0.15	<0.15	0.16	0.15		
1830	<0.15	<0.15	<0.15	0.15	0.16		
1900	<0.15	<0.15	<0.15	0.15	0.16		
1930	<0.15	<0.15	<0.15	0.15	0.15		
2000	<0.15	<0.15	<0.15	0.16	0.16		
2030	<0.15	<0.15	<0.15	0.15	0.17		
2100	<0.15	<0.15	<0.15	<0.15	<0.15		
2130	<0.15	<0.15	<0.15	0.15	0.15		
2200	<0.15	<0.15	<0.15	<0.15	0.15		
2230	<0.15	<0.15	0.16	<0.15	0.17		
2300	<0.15	<0.15	<0.15	0.15	0.15		
2330	<0.15	<0.15	<0.15	<0.15	0.18		
2400	<0.15	<0.15	<0.15	<0.15	<0.15		

Table 26. PAN concentrations in downtown Edmonton, January 1984 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030				<0.15	<0.15	<0.15	0.18	0.18
0100				<0.15	<0.15	<0.15	<0.15	0.22
0130				<0.15	<0.15	<0.15	<0.15	0.24
0200				<0.15	<0.15	<0.15	<0.15	0.18
0230				<0.15	<0.15	<0.15	0.15	0.15
0300				<0.15	<0.15	<0.15	0.15	0.18
0330				<0.15	<0.15	<0.15	<0.15	0.15
0400				<0.15	<0.15	<0.15	<0.15	0.15
0430				<0.15	<0.15	<0.15	<0.15	0.18
0500				<0.15	<0.15	<0.15	0.15	0.15
0530				<0.15	<0.15	<0.15	<0.15	0.17
0600				<0.15	<0.15	<0.15	<0.15	0.15
0630				<0.15	<0.15	<0.15	<0.15	0.15
0700				<0.15	<0.15	<0.15	<0.15	<0.15
0730				<0.15	<0.15	<0.15	<0.15	0.15
0800				<0.15	<0.15	<0.15	<0.15	<0.15
0830				<0.15	<0.15	<0.15	<0.15	<0.15
0900				<0.15	<0.15	<0.15	<0.15	<0.15
0930				<0.15	<0.15	<0.15	<0.15	<0.15
1000				<0.15	<0.15	<0.15	0.16	<0.15
1030				<0.15	<0.15	<0.15	0.15	<0.15
1100				<0.15	<0.15	<0.15	0.17	0.15
1130				<0.15		<0.15	0.19	<0.15
1200				<0.15	<0.15	<0.15	0.17	<0.15
1230				<0.15	<0.15	<0.15	0.17	0.15
1300				<0.15	<0.15	<0.15	0.16	<0.15
1330				<0.15	<0.15	<0.15	0.16	<0.15
1400				<0.15	<0.15	<0.15	0.18	<0.15
1430			<0.15	<0.15	<0.15	<0.15	0.19	<0.15
1500			<0.15	<0.15	<0.15		0.18	0.18
1530			<0.15	<0.15	<0.15	0.17	<0.15	0.19
1600			<0.15	<0.15	<0.15	0.16	0.18	0.18
1630			<0.15	<0.15	<0.15	<0.15	0.18	0.22
1700			<0.15	<0.15	<0.15	<0.15	0.17	0.19
1730			<0.15	<0.15	<0.15	<0.15	0.17	0.22
1800			<0.15	<0.15	<0.15	0.15	0.18	0.18
1830			<0.15	<0.15	<0.15	<0.15	0.21	0.20
1900			<0.15	<0.15	<0.15	0.15	0.21	0.17
1930			<0.15	<0.15	<0.15	<0.15	0.19	0.18
2000			<0.15	<0.15	<0.15	<0.15	0.19	0.23
2030			<0.15	<0.15	<0.15	<0.15	0.19	0.18
2100			<0.15	<0.15	<0.15	<0.15	0.18	<0.15
2130			<0.15	<0.15	<0.15	<0.15	0.19	<0.15
2200			<0.15	<0.15	<0.15	<0.15	0.17	0.17
2230			0.15	<0.15	<0.15	0.20	0.16	0.17
2300			<0.15	<0.15	<0.15	<0.15	0.17	<0.15
2300			0.15	<0.15	<0.15	<0.15	0.18	0.15
2400			<0.15	<0.15	<0.15	<0.15	0.19	0.21

continued...

Table 26. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.18	0.17	0.18	<0.15	<0.15	<0.15	0.16	<0.15
0100	0.16	0.16	0.17	<0.15	<0.15	<0.15	<0.25	<0.15
0130	0.17	0.17	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
0200	0.15	0.16	0.16	<0.15	<0.15	<0.15	<0.15	<0.15
0230	<0.15	0.16	0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0300	<0.15	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0330	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0400	<0.15	0.17	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0430	<0.15	0.16	<0.15	<0.15	<0.15	0.18	<0.15	<0.15
0500	<0.15	0.16	<0.15	<0.15	<0.15	0.18	<0.15	<0.15
0530	<0.15	<0.15	<0.15	<0.15	<0.15	0.16	<0.15	<0.15
0600	<0.15	0.15	<0.15	<0.15	<0.15	0.15	<0.15	<0.15
0600	<0.15	<0.15	<0.15	<0.15	<0.15	0.17	<0.15	<0.15
0700	0.15	<0.15	<0.15	<0.15	<0.15	0.15	<0.15	<0.15
0730	<0.15	<0.15	<0.15	<0.15	<0.15	0.18	<0.15	<0.15
0800	<0.15	<0.15	0.15	<0.15	<0.15	0.15	<0.15	<0.15
0830	<0.15	0.15	0.15	<0.15	<0.15	0.19	<0.15	<0.15
0900	<0.15	<0.15	0.15	<0.15	<0.15	0.16	<0.15	<0.15
0930	<0.15	0.15	0.15	<0.15	<0.15	0.52	<0.15	<0.15
1000	<0.15	<0.15	0.16	<0.15	<0.15	0.20	<0.15	<0.15
1030	<0.15	0.15	0.16	<0.15	<0.15	0.19	0.15	<0.15
1100	<0.15	<0.15	0.17	0.15	<0.15	0.20	<0.15	<0.15
1130	<0.15	0.15	0.17	<0.15		0.17	<0.15	<0.15
1200	<0.15	0.16	0.17	<0.15	<0.15	0.19	<0.15	<0.15
1230	<0.15	0.17	0.16	<0.15	<0.15	0.21	<0.15	<0.15
1300	<0.15	0.17	0.17	0.15	<0.15	0.21	<0.15	<0.15
1330	<0.15	0.17	0.18	<0.15	<0.15	0.19	<0.15	<0.15
1400	<0.15	0.16	0.19	<0.15	<0.15	0.20	<0.15	<0.15
1430	<0.15	0.15	0.19	<0.15	<0.15	0.22	<0.15	0.16
1500	0.15	0.15	0.19	<0.15	<0.15	0.19	<0.15	0.15
1530	0.15	0.17	0.19	<0.15	0.17	0.20	<0.15	0.15
1600	<0.15	0.17	0.18	<0.15	0.16	0.21	<0.15	0.16
1630	0.15	0.18	0.18	<0.15	0.21	0.15	<0.15	0.18
1700	0.16	0.17	0.16	<0.15	<0.15	0.20	0.16	<0.15
1730	0.15	0.18	0.17	<0.15	0.15	0.20	<0.15	0.15
1800	0.16	0.17	0.17	<0.15	0.16	0.19	<0.15	0.15
1830	0.15	0.17	0.19	<0.15	<0.15	0.16	<0.15	<0.15
1900	0.16	0.18	0.19	<0.15	0.23	0.21	<0.15	0.15
1930	0.16	0.16	0.18	<0.15	<0.15	0.17	<0.15	0.15
2000	0.17	0.17	0.19	<0.15	<0.15	0.17	<0.15	<0.15
2030	0.16	0.17	0.18	<0.15	0.17	0.19	<0.15	0.16
2100	0.17	0.16	0.19	<0.15	0.15	0.17	0.15	<0.15
2130	0.17	0.18	0.17	<0.15	<0.15	0.18	<0.15	<0.15
2200	0.17	0.16	0.15	<0.15	<0.15	<0.15	<0.15	<0.15
2230	0.18	0.17	<0.15	<0.15	<0.15	0.15	<0.15	0.16
2300	0.17	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	0.15
2330	0.17	0.18	<0.15	<0.15	0.16	<0.15	0.15	<0.15
2400	0.16	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	0.15

continued...

Table 26. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.15	0.16	0.15	0.21	0.16			<0.15
0100	0.16	0.16	0.18	0.21	0.18			0.15
0130	0.17	0.15	0.18	0.19	0.17			<0.15
0200	0.15	0.15	0.16	0.19	0.22			<0.15
0230	<0.15	0.16	<0.15	0.15	0.21			<0.15
0300	<0.15	<0.15	0.19	0.16	0.20			<0.15
0330	<0.15	<0.15	<0.15	0.15	0.17			
0400	<0.15	<0.15	0.15	<0.15	0.15			
0430	<0.15	<0.15	0.16	<0.15	0.15			
0500	<0.15	<0.15	0.15	<0.15	<0.15			
0530	<0.15	<0.15	0.15	<0.15	<0.15			
0600	<0.15	<0.15	0.15	<0.15	<0.15			
0630	<0.15	<0.15	0.15	<0.15	<0.15			
0700	<0.15	<0.15	<0.15	<0.15	0.15			
0730	<0.15	<0.15	<0.15	<0.15	<0.15			
0800	<0.15	<0.15	0.15	0.15	<0.15			
0830	<0.15	<0.15	<0.15	<0.15	<0.15			0.15
0900	<0.15	<0.15	0.16	<0.15	<0.15			<0.15
0930	<0.15		0.15	<0.15	<0.15			0.15
1000	0.16		0.15	<0.15	0.15			<0.15
1030	0.17		0.16	<0.15	0.15			<0.15
1100	0.15		0.19	<0.15	0.15			<0.15
1130	0.18		0.19	<0.15	0.18			<0.15
1200	0.19		0.15	<0.15	0.19			0.15
1230	0.19		0.19	<0.15	0.19			0.17
1300	0.20	<0.15	0.16	<0.15	0.20			<0.15
1330	0.18	<0.15	0.17	<0.15				0.17
1400	0.17	<0.15	0.15	0.15				<0.15
1430	0.20	<0.15	0.15	<0.15				<0.15
1500	0.20		0.17	0.15				<0.15
1530	0.20	<0.15	0.17	0.15			<0.15	0.17
1600	0.19	<0.15	0.17	0.15			<0.15	0.16
1630	0.20	0.16	0.18	<0.15			<0.15	<0.15
1730	0.21	0.16	0.19	0.16			<0.15	<0.15
1800	0.19	<0.15	0.15	0.15			<0.15	<0.15
1830	0.19	<0.15	0.18	<0.15			<0.15	0.15
1900	0.16	<0.15	0.17	0.16			<0.15	0.15
1930	0.16	<0.15	0.19	<0.15			<0.15	0.15
2000	0.16	<0.15	0.19	<0.15			<0.15	0.15
2030	0.15	<0.15	0.18	0.15			<0.15	0.16
2100	0.16	<0.15	0.22	0.15			<0.15	0.15
2130	0.16	<0.15	0.21	<0.15			<0.15	0.15
2200	0.18	<0.15	0.22	<0.15			<0.15	0.17
2230	0.16	<0.15	0.21	0.19			<0.15	0.17
2300	<0.15	<0.15	0.21	<0.15			<0.15	0.15
2330	<0.15	<0.15	0.22	0.17			<0.15	0.17
2400	<0.15	0<.15	0.21	0.17			<0.15	0.16

continued...

Table 26. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030	0.17	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
0100	0.15	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
0130	0.16	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
0200	<0.15	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
0230	0.18	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
0300	0.17	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0330	0.16	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
0400	0.16	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
0430	0.16	0.15	<0.15	<0.15	<0.15	<0.15	<0.15
0500	0.16	0.16	<0.15	<0.15	<0.15	<0.15	<0.15
0530	0.15	0.24	<0.15	<0.15	<0.15	<0.15	<0.15
0600	0.15	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
0630	0.17	0.20	<0.15	<0.15	<0.15	<0.15	<0.15
0700	0.17	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
0730	0.17	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
0800	0.16	0.21	<0.15	<0.15	<0.15	<0.15	<0.15
0830	0.18	0.17	<0.15	<0.15	<0.15	<0.15	<0.15
0900	0.15	0.18	<0.15	<0.15	<0.15	<0.15	<0.15
0930	<0.15	0.20	<0.15	<0.15	<0.15	<0.15	<0.15
1000	0.16	0.20	<0.15	<0.15	<0.15	0.16	
1030	0.15	0.19	<0.15	<0.15	<0.15	0.18	
1100	0.17	0.18	<0.15	<0.15	<0.15	0.18	0.18
1130	0.18	0.17	<0.15	<0.15	<0.15	0.19	0.18
1200	0.18	0.19	<0.15	<0.15	<0.15	0.20	0.22
1230	0.20	0.21	<0.15	0.15	<0.15	0.19	0.17
1300		0.24	<0.15	<0.15	<0.15	0.17	0.20
1330	0.23	0.20	<0.15	<0.15	<0.15	0.20	0.18
1400	0.17	0.20	<0.15	<0.15	<0.15	0.20	0.20
1430	0.22	0.21	<0.15	<0.15	<0.15	0.22	0.21
1500	0.21	0.22	<0.15	<0.15	<0.15	0.21	0.23
1530	0.24	0.24	<0.15	0.15	0.15	0.19	0.21
1600	0.21	0.22	<0.15	0.16	0.15	0.24	0.22
1630	0.17	0.21	<0.15	0.15	0.16	0.24	0.20
1700	0.16	0.22	<0.15	0.15	0.15	0.27	0.26
1730	0.17	0.22	<0.15	<0.15	<0.15	0.24	0.23
1800	0.16	0.23	<0.15	<0.15	<0.15	0.24	0.18
1830	0.16	0.23	<0.15	<0.15	<0.15	0.24	0.18
1900	0.17	0.22	<0.15	<0.15	<0.15	0.21	0.18
1930	0.15	0.23	<0.15	<0.15	<0.15	0.16	0.17
2000	0.15	0.21	<0.15	<0.15	<0.15	0.15	0.20
2030	0.15	0.22	<0.15	<0.15	<0.15	<0.15	0.25
2100	0.15	0.17	<0.15	<0.15	<0.15	0.16	0.24
2130	0.15	0.19	<0.15	<0.15	0.18	0.16	0.20
2200	0.15	0.20	<0.15	<0.15	0.15	0.16	0.21
2230	0.16	0.21	<0.15	<0.15	0.15	<0.15	0.23
2300	0.17	0.16	<0.15	<0.15	<0.15	0.15	0.21
2330	0.17	0.18	<0.15	<0.15	0.15	0.15	0.21
2400	0.15	<0.15	<0.15	<0.15	<0.15	0.15	0.18

Table 27. PAN concentrations in downtown Edmonton, February 1984 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	0.20	<0.15	0.15	0.16		<0.15	0.16	0.25
0100	0.16	<0.15	<0.15	<0.15	<0.15	<0.15	0.17	0.23
0130	0.21	<0.15	<0.15	<0.15	<0.15	<0.15	0.16	0.21
0200	0.25	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.23
0230	0.21	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.22
0300	0.18	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.23
0330	0.19	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.20
0400	0.21	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.19
0430	0.20	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.21
0500	0.20	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.17
0530	0.21	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.18
0600	0.23	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.18
0630	0.22	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	0.16
0700	0.23	<0.15	<0.15	0.16	<0.15	<0.15	<0.15	0.15
0730	0.21	<0.15	0.15	0.17	<0.15	<0.15	0.15	0.15
0800	0.16	<0.15	0.15	<0.15	<0.15	<0.15	<0.15	0.15
0830	<0.15	<0.15	0.15	0.15	<0.15	0.17	0.16	0.16
0900	<0.15	<0.15	0.15	<0.15	<0.15	0.20	<0.15	0.15
0930	<0.15	0.16	0.15	0.15	<0.15	0.22	0.19	0.15
1000	<0.15	<0.15	0.16	<0.15	<0.15	0.19	0.18	0.16
1030	<0.15	<0.15	<0.15	<0.15	<0.15	0.23	0.20	
1100	<0.15	<0.15	<0.15	0.17	<0.15	0.23	0.21	0.20
1130	<0.15	<0.15	0.15	0.15		0.24	0.24	0.22
1200	<0.15	<0.15	<0.15	0.18	<0.15	0.26	0.27	0.18
1230	<0.15		<0.15	<0.15	<0.15	0.28	0.27	0.21
1300	<0.15		0.16	0.16	<0.15	0.33	0.29	0.23
1330	0.15		<0.15	<0.15	<0.15	0.37	0.27	0.18
1400	<0.15	<0.15	<0.15	0.16	<0.15	0.40	0.31	0.21
1430	<0.15	<0.15	0.17	0.15	<0.15	0.42	0.30	0.20
1500	<0.15	0.15	0.15	0.16	<0.15	0.48	0.31	0.21
1530	<0.15	0.20	<0.15	0.16	<0.15	0.54	0.31	0.21
1600	<0.15	0.15	<0.15	0.18	<0.15	0.50	0.31	0.17
1630	<0.15	0.18	0.19	0.17	<0.15	0.54	0.31	0.21
1700	<0.15	0.20	0.16	0.17	<0.15	0.50	0.29	0.19
1730	<0.15	0.19	0.15	<0.15	0.53	0.27	0.19	0.43
1800	<0.15	0.15	0.17	<0.15	0.48	0.27	0.21	0.46
1830	<0.15	0.16	0.17	<0.15	0.46	0.25	0.20	0.47
1900	<0.15	0.18	0.17	<0.15	0.41	0.25	0.20	0.49
1930	<0.15	0.17	0.17	<0.15	0.38	0.28	0.22	0.44
2000	<0.15	0.16	0.18	<0.15	0.35	0.26	0.19	0.43
2030	0.15	0.15	0.19	<0.15	0.34	0.26	0.19	0.41
2100	0.15	0.18	0.18	<0.15	0.34	0.25	0.18	0.37
2130	0.16	0.15	0.21	<0.15	0.29	0.25	0.23	0.37
2200	<0.15	<0.15	0.22	<0.15	0.25	0.25	0.22	0.32
2230	<0.15	0.15	0.20	<0.15	0.24	0.25	0.18	0.29
2300	0.16	0.16	0.18	<0.15	0.24	0.24	0.19	0.28
2330	0.15	0.16	0.20	<0.15	0.19	0.25	0.17	0.30
2400	0.15	<0.15	0.18	<0.15	0.19	0.24	0.16	0.27

continued...

Table 27. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.17	0.23	<0.15	0.24	0.19	0.24	<0.15	0.26
0100	0.17	0.21	0.17	0.24	0.18	0.19	0.18	0.30
0130	0.17	0.22	0.17	0.25	0.17	0.21	0.15	0.34
0200	0.16	0.21	0.18	0.25	0.15	0.20	0.15	0.33
0230	<0.15	0.20	0.17	0.22	0.16	0.19	0.15	0.30
0300	<0.15	0.18	0.18	0.23	<0.15	0.19	<0.15	0.31
0330	<0.15	0.20	0.18	0.22	<0.15	0.18	0.17	0.33
0400	<0.15	0.20	0.18	0.21	<0.15	0.18	0.18	0.31
0430	<0.15	0.20	0.19	0.21	<0.15	0.19	<0.15	0.34
0500	<0.15	0.21	0.18	0.21	<0.15	0.19	0.15	0.31
0530	<0.15	0.19	0.18	0.19	<0.15	0.19	0.15	0.31
0600	<0.15	0.21	0.18	0.18	<0.15	0.20	0.16	0.29
0630	<0.15	0.23	0.18	0.16	<0.15	0.20	0.15	0.24
0700	<0.15	0.25	0.18	0.15	<0.15	0.26	0.15	0.21
0730		0.23	0.18	<0.15	<0.15	0.26	<0.15	0.19
0800	<0.15	0.24	0.19	<0.15	<0.15	0.24	<0.15	0.17
0830	0.17	0.22	0.21	<0.15	0.15	0.25	<0.15	0.15
0900	<0.15	0.26	0.20	<0.15	0.17	0.25	0.18	0.17
0930	0.19	0.27	0.33	0.15	0.16	0.26	0.20	0.18
1000	0.22	0.27	0.21	0.16	0.15	0.23	0.21	0.16
1030	0.23	0.26	0.21	0.18	0.17	0.19	0.26	0.17
1100	0.27	0.29	0.19	0.17	0.16	0.22	0.30	<0.15
1130	0.28	0.25	0.18	0.19	0.19	0.22	0.31	<0.15
1200	0.31	0.28	0.18	0.19	0.22	0.33	0.34	0.17
1230	0.35	0.27	0.20	0.17	0.20	0.36	0.24	0.15
1300	0.36	0.28	0.22	0.21	0.20	0.24	0.25	0.18
1330	0.35	0.31	0.23	0.18	0.23	0.18	0.25	0.15
1400	0.32	0.31	0.23	0.18	0.29	0.19	0.25	0.15
1430	0.37	0.30	0.26	0.18	0.46	0.20	0.34	0.17
1500	0.35	0.32	0.26	0.19	0.41	0.19	0.36	0.18
1530	0.34	0.32	0.27	0.20	0.42	0.20	0.24	0.20
1600	0.34	0.30	0.29	0.23	0.39	0.20	0.22	0.19
1630	0.37	0.32	0.32	0.22	0.37	0.20	0.22	0.18
1700	0.39	0.28	0.32	0.21	0.36	0.19	0.28	0.19
1730	0.23	0.33	0.20	0.27	0.21	0.27	0.20	0.24
1800	0.18	0.33	0.20	0.24	0.18	0.25	0.20	0.22
1830	0.16	0.31	0.18	0.29	0.18	0.23	0.18	0.21
1900	0.18	0.29	0.19	0.25	0.18	0.22	0.18	0.22
1930	0.18	0.29	0.21	0.25	0.19	0.23	0.18	0.23
2000	0.17	0.28	0.19	0.27	<0.15	0.23	0.19	0.22
2030	0.17	0.27	0.19	0.27	0.15	0.24	0.16	0.21
2100	<0.15	0.29	0.19	0.23	0.16	0.21	0.18	0.24
2130	0.15	0.27	0.21	0.23	0.18	0.23	0.17	0.22
2200	<0.15	0.27	0.20	0.23	0.18	0.22	0.15	0.23
2230	0.15	0.27	0.19	0.24	0.16	0.24	0.16	0.25
2300	<0.15	0.27	0.20	0.23	0.18	0.46	0.17	0.25
2330	0.16	0.26	0.19		0.19	0.48	0.17	0.24
2400	<0.15	0.26	0.19	0.19	0.19	0.35	0.18	0.25

continued...

Table 27. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.15	0.25	0.19	0.23	0.16	0.15	0.16	0.17
0100	<0.15	0.22	0.17	0.22	0.15	0.15	0.16	0.15
0130	0.16	0.26	0.20	0.20	<0.15	<0.15	0.18	<0.15
0200	0.16	0.24	0.20	0.21	<0.15	<0.15	0.17	<0.15
0230	0.16	0.22	0.19	0.17	<0.15	<0.15	0.15	<0.15
0300	<0.15	0.22	0.17	0.15	<0.15	<0.15	0.19	<0.15
0330	0.16	0.22	0.17	<0.15	<0.15	<0.15	0.18	
0400	0.15	0.21	0.19	<0.15	<0.15	<0.15	0.19	
0430	0.17	0.20	0.17	<0.15	0.15	<0.15	0.18	
0500	0.17	0.21	<0.15	<0.15	<0.15	<0.15	0.19	
0530	0.17	0.19	<0.15	<0.15	<0.15	0.15	0.16	
0600	<0.15	0.18	0.15	<0.15	<0.15	<0.15	0.17	
0630	0.17	0.19	<0.15	<0.15	<0.15	<0.15	0.16	
0700	<0.15	0.18	0.16	<0.15	0.15	0.15	0.16	
0730	0.15	0.18	0.16	<0.15	<0.15	<0.15	<0.15	
0800	0.16	0.18	0.16	<0.15	<0.15	0.15	0.16	
0830	0.16	0.17	<0.15	<0.15	0.18	0.16	0.18	0.15
0900	0.17	0.20	0.16	<0.15	0.18	0.17	0.16	<0.15
0930	0.19	0.16	0.19	<0.15	0.20	0.17	0.19	0.15
1000	0.17	0.17	0.22	<0.15	0.19	0.20	0.21	<0.15
1030	0.15	0.20	0.22	<0.15	0.19	0.22	0.22	0.25
1100	0.17	0.22	0.25	0.15	0.20	0.24	0.19	0.26
1130	0.19	0.23	0.26	0.20	0.18	0.22	0.18	0.33
1200	0.18	0.26	0.21	0.16	0.15	0.23	0.16	0.38
1230	0.20	0.31	0.27	0.29	0.17	0.19	0.18	0.46
1300	0.19	0.29	0.27	0.34	0.17	0.20	0.18	0.42
1330	0.20	0.31	0.28	0.30	0.16	0.19	0.16	0.41
1400	0.18	0.32	0.27	0.27	0.15	0.17	0.15	0.36
1430	0.21	0.24	0.32	0.23	0.15	0.21	0.15	0.28
1500	0.20	0.22	0.28	0.18	<0.15	0.19	0.16	0.20
1530	0.21	0.22	0.31	0.16	0.16	0.18	<0.15	0.15
1600	0.23	0.28	0.35	0.18	0.16	0.29	<0.15	0.17
1630	0.24	0.25	0.36	0.16	<0.15	0.22	0.16	0.15
1700	0.24	0.25	0.38	0.19	0.15	0.20	0.17	0.19
1730	0.25	0.39	0.16	0.17	0.20	0.20	0.37	0.28
1800	0.29	0.35	<0.15	0.19	0.18	0.20	0.32	0.28
1830	0.28	0.35	0.16	0.16	0.20	0.19	0.22	0.27
1900	0.26	0.33	0.18	0.20	0.22	0.17	0.21	0.27
1930	0.29	0.32	0.17	0.17	0.22	0.17	0.20	0.26
2000	0.26	0.30	0.19	0.16	0.21	0.20	0.22	0.26
2030	0.26	0.31	0.19	0.16	0.18	0.18	0.21	0.27
2100	0.20	0.28	0.20	0.17	0.20	<0.15	0.19	0.31
2130	0.23	0.30	0.19	0.15	0.20	0.16	0.19	0.22
2200	0.18	0.31	0.20	0.15	0.16	0.18	0.19	0.22
2230	0.20	0.33	0.18	0.18	0.18	0.17	0.19	0.20
2300	0.19	0.28	0.20	<0.15	0.19	0.17	0.19	0.20
2330	0.19	0.29	0.17	<0.15	0.17	0.17	0.19	0.20
2400	0.22	0.27	0.19	<0.15	0.16	<0.15	0.23	0.19

continued...

Table 27. Concluded.

Day	25	26	27	28	29
Time					
0030	0.22	0.16	0.24	0.17	0.23
0100	0.23	<0.15	0.23	0.18	0.23
0130	0.25	<0.15	0.21	0.17	0.23
0200	0.27	<0.15	0.18	0.17	0.22
0230	0.24	<0.15	0.18	0.18	0.21
0300	0.23	0.15	0.19	0.19	0.23
0330	0.23	<0.15	0.17	0.16	0.21
0400	0.22	<0.15	0.19	0.18	0.21
0430	0.23	0.15	0.16	0.17	0.20
0500	0.20	0.16	0.18	0.15	0.22
0530	0.21	0.15	0.17	0.18	0.22
0600	0.20	0.15	0.15	0.18	0.23
0630	0.21	0.16	0.16	0.17	0.24
0700	0.20	0.16	0.16	<0.15	0.22
0730	0.19	0.15	0.16	0.15	0.24
0800	0.21	0.16	0.16	0.18	0.21
0830	0.21	0.16	0.15	0.18	0.20
0900	0.22	0.18	0.18	0.18	0.22
0930	0.22	0.19	0.18	0.17	0.22
1000	0.26	0.19	0.19	0.18	0.25
1030	0.27	0.21	0.18	0.19	0.26
1100	0.27	0.20	0.17	0.18	0.23
1130	0.30	0.21	0.18	0.22	0.24
1200	0.22	0.25	0.20	0.19	0.31
1230	0.18	0.20	0.17	0.22	0.27
1300	0.27	0.20	0.21	0.21	0.32
1330	0.27	0.20	0.21	0.20	0.32
1400	0.21	0.21	0.22	0.25	0.30
1430	0.23	0.23	0.23	0.27	0.33
1500	0.22	0.25	0.24	0.21	0.32
1530	0.26	0.19	0.30	0.20	0.31
1600	0.29	0.17	0.25	0.20	0.30
1630	0.30	0.24	0.28	0.22	0.42
1700	0.31	0.56	0.27		<0.15
1730	0.45	0.26	0.26	0.41	<0.15
1800	0.21	0.26	0.26	0.40	<0.15
1830	0.27	0.24	0.24	0.66	<0.15
1900	0.23	0.25	0.23	0.37	<0.15
1930	0.25	0.21	0.29	0.28	<0.15
2000	0.22	0.20	0.26	0.31	<0.15
2030	0.21	0.19	0.25	0.28	<0.15
2100	0.19	0.19	0.25	0.29	<0.15
2130	0.20	0.16	0.22	0.29	<0.15
2200	0.24	0.17	0.21	0.32	<0.15
2230	0.25	0.20	0.22	0.34	<0.15
2300	0.27	0.18	0.20	0.30	<0.15
2330	0.22	0.15	0.22	0.30	<0.15
2400	0.20	0.19	0.22	0.31	<0.15

Table 28. PAN concentrations in downtown Edmonton, March 1984 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	0.29	0.23	0.15	<0.15	0.20	0.18	0.17	
0100	0.25	0.23	<0.15	<0.15	0.15	0.17	0.17	
0130	0.24	0.19	<0.15	<0.15	0.20	0.15		
0200	0.21	0.21	<0.15	<0.15	0.20	0.17		
0230	0.22	0.21	0.15	<0.15	0.18	0.15		
0300	0.23	0.20	0.15	<0.15	0.15	0.16		
0330	0.25	0.23	<0.15	0.15	0.17	<0.15		
0400	0.23	0.20	<0.15	<0.15	<0.15	<0.15		
0430	0.24	0.18	<0.15	<0.15	<0.15	<0.15		
0500	0.22	0.19	<0.15	<0.15	<0.15	<0.15		
0530	0.20	0.17	<0.15	<0.15	<0.15	<0.15		
0600	0.23	0.18	<0.15	<0.15	<0.15	0.15		
0630	0.22	0.20	<0.15	<0.15	<0.15	<0.15		
0700	0.23	0.19	<0.15	<0.15	<0.15	<0.15		
0730	0.22	0.18	<0.15	<0.15	<0.15	<0.15		
0800	0.22	0.18	<0.15	0.15	<0.15	<0.15		
0830	0.24	0.19	<0.15	0.15	<0.15	0.15		
0900	0.24	0.23	<0.15	0.19	<0.15	0.17		
0930	0.22	0.22	<0.15	0.20	<0.15	0.18		
1000	0.18	0.22	<0.15	0.23	<0.15	0.17		
1030	0.16	0.21	<0.15	0.21	<0.15	<0.15		
1100	0.18	0.18	<0.15	0.27	<0.15	0.15		
1130	0.17	0.19	<0.15	0.31	<0.15	0.16		
1200	0.18	<0.15	<0.15	0.23	<0.15	0.16		
1230	0.21	0.19	<0.15	0.22	<0.15	0.20		
1300	0.18	0.19	<0.15	0.17	<0.15	<0.15		
1330	0.17	0.20	<0.15	0.21	<0.15	0.18		0.31
1400	0.20	0.22	<0.15	0.19	<0.15	0.19		
1430	0.21	0.29	<0.15	0.21	<0.15	0.20		0.31
1500	0.18	0.28	<0.15	0.22	<0.15	0.17	0.22	0.29
1530	0.21	0.34	<0.15	0.22	0.15	0.17	0.22	0.25
1600	0.21	0.38	<0.15	0.24	<0.15	0.18	0.25	0.26
1630	0.21	0.35	<0.15	0.22	<0.15	0.20	0.22	0.26
1700	0.22	0.37	<0.15	0.23	0.17	0.16	0.25	0.27
1730	0.22	0.36	<0.15	0.27	0.19	0.17	0.27	0.25
1800	0.23	0.42	<0.15	0.28	0.16	0.16	0.27	0.26
1830	0.22	0.31	<0.15	0.24	0.20	0.17	0.27	0.27
1900	0.23	0.26	<0.15	0.22	0.16	<0.15	0.31	0.26
1930	0.22	0.24	<0.15	0.23	0.21	<0.15	0.32	0.25
2000	0.21	0.21	<0.15	0.23	0.17	0.16	0.31	0.25
2030	0.21	0.23	<0.15	0.21	0.19	0.17	0.32	0.25
2100	0.22	0.20	<0.15	0.22	0.17	<0.15	0.31	0.34
2130	0.21	0.25	<0.15	0.20	0.19	0.15		0.26
2200	0.23	0.24	<0.15	0.19	0.18	<0.15		0.24
2230	0.21	0.23	<0.15	0.21	0.17	0.16		0.27
2300	0.19	0.20	<0.15	0.18	0.19	<0.15		0.25
2330	0.19	0.17	<0.15	0.17	<0.15	0.16		0.26
2400	0.21	0.16	<0.15	0.16	0.17	0.17		0.24

continued...

Table 28. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.24	0.20	0.26	0.28	0.41	0.30	0.66	
0100	0.24	0.16	0.27	0.28	0.44	0.33	0.65	
0130	0.25	0.16	0.28	0.30	0.41	0.33	0.65	
0200	0.26	0.16	0.27	0.28	0.44	0.32	0.70	
0230	0.27	0.18	0.27	0.30	0.44	0.30	0.65	
0300	0.26	0.17	0.26	0.29	0.46	0.29	0.65	
0330	0.27	0.16	0.26	0.30	0.37	0.29	0.64	
0400	0.27	0.19	0.24	0.29	0.38	0.27	0.68	
0430	0.25	0.19	0.23	0.29	0.37	0.29	0.70	
0500	0.29	0.18	0.23	0.27	0.41	0.28	0.66	
0530	0.27	0.18	0.22	0.26	0.42	0.29	0.68	
0600	0.28	0.18	0.23	0.26	0.42	0.29	0.61	
0630	0.27	0.18	0.22	0.28	0.40	0.29	0.66	
0700	0.26	0.19	0.21	0.29	0.47	0.30	0.70	
0730	0.25	0.21	0.21	0.29	0.36	0.37	0.63	
0800	0.31	0.20	0.23		0.37	0.41	0.77	
0830	0.29	0.21	0.22		0.40	0.44	0.82	
0900	0.29	0.20	0.23	0.33	0.38	0.38	0.89	
0930	0.30	0.19	0.23	0.33	0.39	0.38	0.93	
1000	0.32	0.19	0.23	0.34	0.35	0.37	0.77	
1030	0.34	0.20	0.23		0.32	0.37	0.70	
1100	0.31	0.21	0.24	0.28	0.33	0.38	0.69	
1130	0.37	0.21	0.23	0.28	0.34	0.35	0.64	
1200	0.35	0.21	0.22	0.28	0.33	0.36	0.80	
1230	0.35	0.22	0.24	0.27	0.37	0.33	0.75	
1300	0.36	0.25	0.25	0.29	0.30	0.31	0.77	
1330	0.30	0.25	0.24	0.33	0.22	0.45	0.81	
1400	0.25	0.27	0.24	0.31	0.33	0.46	0.69	
1430	0.25	0.27	0.25	0.28	0.33	0.47	0.69	
1500	0.16	0.26	0.26	0.31	0.31	0.46	0.81	
1530	0.18	0.29	0.27	0.31	0.29	0.48	0.75	
1600	0.18	0.31	0.27	0.28	0.29	0.47	0.80	
1630	0.18	0.33	0.27	0.29	0.31	0.58		
1700	0.18	0.32	0.27	0.30	0.31	0.59		
1730	<0.15	0.34	0.28	0.30	0.35	0.62		
1800	<0.15	0.31	0.28	0.31	0.40	0.55		
1830	<0.15	0.29	0.28	0.27	0.38	0.59		
1900	<0.15	0.31	0.29	0.34	0.37	0.59		
1930	0.17	0.31	0.27	0.33	0.40	0.59		
2000	0.17	0.31	0.26	0.35	0.40	0.61		
2030	0.19	0.28	0.26	0.36	0.40	0.62		
2100	0.20	0.27	0.29	0.30	0.43	0.64		
2130	0.20	0.28	0.27	0.37	0.48	0.65		
2200	0.20	0.30	0.27	0.37	0.41	0.58		
2230	0.22	0.28	0.28	0.38	0.39	0.63		
2300	0.21	0.27	0.28	0.40	0.36	0.68		
2330	0.20	0.27	0.27	0.37	0.36	0.71		
2400	0.20	0.26	0.27	0.43	0.36	0.66		

continued...

Table 28. Concluded.

Day	17	18	19	20	21	22	23	24
Time								
0030				0.19	0.30			
0100				0.21	0.25			
0130				0.19				
0200				0.23				
0230				0.19				
0300				0.21				
0330				0.19				
0400				0.21				
0430				0.16				
0500				0.21				
0530				0.17				
0600				0.22				
0630				0.17				
0700				0.24				
0730				0.24				
0800				0.31				
0830				0.36				
0900				0.35				
0930				0.45				
1000			0.26	0.45				
1030			0.23	0.40				
1100			0.23	0.44				
1130			0.22	0.50				
1200			0.23	0.38				
1230			0.26	0.26				
1300			0.19	0.23				
1330			0.22	0.33				
1400			0.23	0.30				
1430			0.24	0.57				
1500			0.28	0.49				
1530			0.26	0.43				
1600			0.25	0.35				
1630			0.29	0.34				
1700			0.26	0.36				
1730			0.30	0.40				
1800			0.29	0.38				
1830			0.27	0.41				
1900			0.28	0.34				
1930			0.26	0.38				
2000			0.24	0.42				
2030			0.30	0.36				
2100			0.26	0.36				
2130			0.27	0.42				
2200			0.25	0.39				
2230			0.26	0.37				
2300			0.23	0.33				
2330			0.24	0.37				
2400			0.24	0.35				

Table 29. PAN concentrations in downtown Edmonton, April 1984 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030			0.44	0.55	0.58	0.50	0.23	0.41
0100			0.45	0.51	0.47	0.56	0.25	0.45
0130			0.43	0.52	0.54	0.47	0.24	0.41
0200			0.51	0.54	0.53	0.43	0.22	0.39
0230			0.47	0.57	0.55	0.37	0.25	0.36
0300			0.47	0.54	0.52	0.73	0.25	0.34
0330			0.44	0.55	0.53	1.24	0.25	0.33
0400			0.43	0.53	0.51	0.46	0.23	0.34
0430			0.47	0.45	0.46	0.44	0.24	0.30
0500			0.42	0.46	0.43	0.94	0.24	0.26
0530			0.46	0.41	0.39	0.54	0.24	0.27
0600			0.45	0.43	0.33	0.36	0.23	0.25
0630			0.48	0.44	0.32	0.38	0.23	0.26
0700			0.54	0.44	0.32	0.50	0.25	0.29
0730			0.53	0.43	0.32	0.52	0.25	0.30
0800			0.53	0.52	0.32	0.32	0.27	0.33
0830			0.58	0.52	0.32	0.33	0.34	0.31
0900			0.61	0.59	0.35	0.41	0.34	0.35
0930			0.62	0.39	0.38	0.57	0.33	0.37
1000			0.65	0.35	0.45	0.71	0.36	0.38
1030			0.64	0.42		0.62	0.40	0.41
1100			0.57	0.42	0.54	0.47	0.35	0.43
1130			0.61	0.44	0.61	0.41	0.31	0.42
1200			0.61	0.47	0.60	0.46	0.34	0.45
1230			0.66	0.44	0.64	0.51	0.27	0.47
1300			0.62	0.46	0.65	0.58	0.27	0.47
1330			0.71	0.65	0.76	0.59	0.28	0.45
1400			0.69	0.56	0.76	0.63	0.32	0.43
1430			0.70	0.44	0.77	0.68	0.31	0.46
1500			0.71	0.46	0.80	0.73	0.35	0.43
1530			0.70	0.49	0.91	0.72	0.35	0.44
1600			0.67	0.49	0.96	0.67	0.35	0.49
1630		0.69	0.75	0.55	0.62	0.56	0.35	0.49
1700		0.68	0.70	0.62	0.55	0.63	0.35	0.45
1730		0.71	0.67	0.63	0.54	0.62	0.38	0.47
1800		0.66	0.70	0.67	0.52	0.57	0.42	0.48
1830		0.73	0.70	0.70	0.53	0.59	0.47	0.52
1900		0.69	0.72	0.69	0.53	0.50	0.53	0.48
1930		0.73	0.69	0.65	0.55	0.41	0.52	0.37
2000		0.86	0.64	0.57	0.62	0.35	0.48	0.39
2030		0.61	0.70	0.52	0.59	0.33	0.47	0.40
2100		0.59	0.68	0.71	0.65	0.35	0.46	0.45
2130		0.60	0.64	1.14	1.11	0.34	0.48	0.41
2200		0.64	0.66	1.19	0.68	0.32	0.44	0.42
2230		0.55	0.62	0.79	0.49	0.29	0.45	0.41
2300		0.49	0.61	0.65	0.47	0.30	0.43	0.38
2330		0.46	0.60	0.58	0.58	0.26	0.38	0.38
2400		0.46	0.59	0.87	0.69	0.24	0.38	0.40

continued...

Table 29. Continued.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.38	0.45	0.72	0.63	0.46	0.52	0.33	0.23
0100	0.42	0.43	0.68	0.64	0.45	0.49	0.34	0.26
0130	0.43	0.41	0.71	0.64	0.41	0.48	0.40	0.27
0200	0.42	0.41	0.58	0.59	0.65	0.44	0.46	0.20
0230	0.41	0.41	0.58	0.48	0.45	0.43	0.46	0.18
0300	0.40	0.44	0.63	0.43	0.47	0.44	0.42	0.21
0330	0.40	0.41	0.61	0.41	0.47	0.38	0.39	0.20
0400	0.39	0.40	0.56	0.37	0.46	0.48	0.40	0.28
0430	0.36	0.40	0.54	0.37	0.34	0.33	0.38	0.23
0500	0.35	0.41	0.52	0.32	0.47	0.34	0.36	0.27
0530	0.33	0.37	0.48	0.29	0.35	0.33	0.33	0.22
0600	0.33	0.34	0.49	0.28	0.31	0.30	0.33	0.24
0630	0.31	0.33	0.57	0.27	0.49	0.32	0.36	0.33
0700	0.32	0.37	0.53	0.26	0.51	0.35	0.35	0.28
0730	0.31		0.55	0.33	0.33	0.37	0.35	0.25
0800	0.36		0.52	0.37	0.45	0.35	0.40	0.34
0830	0.48		0.50	0.44	0.51	0.39	0.38	0.35
0900	0.52		0.49	0.50	0.58	0.36	0.34	0.42
0930	0.42	0.55	0.50		0.54	0.40	0.33	0.51
1000	0.42	0.59	0.43	0.56	0.56	0.42	0.43	0.55
1030	0.55	0.79	0.47		0.63	0.43	0.45	0.58
1100	0.42	1.03	0.47	0.45	0.51	0.48	0.47	0.53
1130	0.38	0.98	0.52	0.43	0.61	0.48	0.51	0.69
1200	0.36	0.56	0.51	0.40	0.72	0.56	0.53	0.71
1230	0.43	0.66	0.57	0.39	0.68	0.59	0.54	0.81
1300	0.41	0.52	0.58	0.60	0.66	0.53	0.46	0.93
1330	0.38	0.50	0.55	0.61	0.64	0.71	0.41	1.20
1400	0.42	0.58	0.51	0.48	0.60	0.64	0.42	1.70
1430	0.45	0.58	0.57	0.53	0.84	0.65	0.45	1.67
1500	0.43	0.57	0.59	0.48	0.55	0.65	0.49	1.12
1530	0.48	0.63	0.61	0.49	0.52	0.80	0.42	0.93
1600	0.47	0.60	0.61	0.58	0.55	0.63	0.41	0.90
1630	0.49	0.65	0.55	0.57	0.60	0.94	0.51	1.32
1700	0.50	0.71	0.52	0.57	0.71	0.77	0.33	0.58
1730	0.48	0.71	0.61	0.72	0.50	0.77	0.30	1.10
1800	0.51	0.77	0.74	0.47	0.46	0.67	0.40	0.97
1830	0.58	0.77	0.80	0.57	0.49	0.54	0.41	0.55
1900	0.59	0.84	0.93	0.53	0.47	0.66	0.42	0.36
1930	0.59	0.86	0.81	0.67	0.48	0.55	0.37	0.30
2000	0.59	0.91	0.75	0.55	0.51	0.56	0.40	0.33
2030	0.52	0.92	0.74	0.62	0.43	0.55	0.47	0.28
2100	0.51	0.87	0.66	0.58	0.47	0.54	0.32	0.30
2130	0.48	0.97	0.57	0.45	0.54	0.55	0.30	0.30
2200	0.49	0.83	0.50	0.48	0.38	0.53	0.30	0.26
2230	0.49	0.80	0.56	0.42	0.40	0.45	0.27	0.28
2300	0.52	0.76	0.61	0.49	0.46	0.40	0.30	0.25
2330	0.49	0.73	0.63	0.45	0.44	0.41	0.30	0.25
2400	0.47	0.75	0.63	0.44	0.46	0.39	0.22	0.21

continued...

Table 29. Continued.

Day	17	18	19	20	21	22	23	24
Time								
0030	0.26	0.30	0.23	0.24	0.81	0.21	0.31	0.43
0100	<0.15	0.29	0.23	<0.15	0.78	0.28	0.31	0.39
0130	<0.15	0.34	0.20	0.17	0.81	0.19	0.36	0.41
0200	0.26	0.32	0.19	0.20	0.71	0.17	0.37	0.41
0230	0.32	0.34	0.19	<0.15	0.69	0.20	0.35	0.37
0300	0.26	0.30	0.20	0.16	0.70	0.22	0.36	0.43
0330	0.33	0.30	<0.15	0.16	0.63	0.22	0.32	0.38
0400	0.29	0.30	0.15	<0.15	0.59	0.22	0.32	0.31
0430	0.36	0.29	<0.15	<0.15	0.48	0.24	0.33	0.34
0500	0.34	0.26	0.23	<0.15	0.50	0.21	0.34	0.39
0530	0.33	0.28	<0.15	<0.15	0.51	0.20	0.28	0.36
0600	0.26	0.29	<0.15	<0.15	0.51	0.23	0.32	0.36
0630	0.31	0.28	0.16	0.17	0.54	0.22	0.32	0.38
0700	0.27	0.36	0.18	<0.15	0.59	0.23	0.33	0.38
0730	0.37	0.33	0.17	0.17	0.55	0.24	0.28	0.45
0800	0.37	0.28		0.17	0.64	0.26	0.25	0.45
0830	0.38	0.30	0.21	0.15	0.59	0.17	0.29	0.39
0900	0.34	0.38	<0.15	0.32	0.85	0.23	0.26	0.40
0930	0.36	0.37	<0.15	0.77	0.83	0.23	0.32	0.39
1000	0.33	0.42	0.20	0.40	0.85	0.25	0.30	0.48
1030	0.44	0.43	<0.15	0.30	0.93	0.21	0.32	0.39
1100	0.40	0.46	0.23	0.43	0.84	0.28	0.32	0.37
1130	0.36	0.46	<0.15	0.45	0.84	0.25	0.31	0.35
1200	0.36	0.44	0.22		0.91	0.23	0.37	0.34
1230	0.50	0.46	0.22		0.65	0.24	0.42	0.36
1300	0.41	0.54	0.31		0.79	0.30	0.38	0.39
1330	0.38	0.44	0.31	0.90	0.54	0.36	0.42	0.38
1400	0.57	0.48	0.29	0.90	0.57	0.34	0.41	0.36
1430	0.41	0.46	0.43	0.91	0.61	0.37	0.33	0.40
1500	0.40	0.50	0.43	0.88	0.57	0.40	0.39	0.38
1530	0.42	0.46	0.57	0.81	0.44	0.36	0.35	
1600	0.46	0.51	0.61	0.90	0.37	0.42	0.36	
1630	0.39	0.54	0.67	0.91	0.45	0.36	0.49	
1700	0.34	0.61	0.88	0.84	0.65	0.36	0.44	
1730	0.42	0.60	1.03	0.77	0.54	0.33	0.41	
1800	0.43	0.59	0.78	0.85	0.58	0.38	0.37	
1830	0.47	0.38	0.76	0.86	0.51	0.32	0.40	
1900	0.43	0.43	0.42	0.92	0.42	0.36	0.34	
1930	0.46	0.34	0.36	1.04	0.37	0.35	0.40	
2000	0.41	0.33	0.37	1.12	0.33	0.30	0.39	
2030	0.40	0.30	0.33	1.09	0.44	0.31	0.39	
2100	0.31	0.31	0.26	1.05	0.31	0.37	0.40	
2130	0.32	0.33	0.24	1.07	0.29	0.34	0.39	
2200	0.29	0.29	0.26	1.06	0.29	0.37	0.42	
2230	0.31	0.40	0.28	1.04	0.21	0.28	0.37	
2300	0.26	0.29	0.28	0.94	0.23	0.44	0.37	
2330	0.34	0.28	0.20	0.96	0.25	0.37	0.40	
2400	0.31	0.26	0.24	0.94	0.25	0.37	0.44	

continued...

Table 29. Concluded.

Day	25	26	27	28	29	30
Time						
0030		0.25	0.38	0.65	0.55	0.54
0100		0.27	0.35	0.59	0.52	0.57
0130		0.31	0.44	0.56	0.51	0.53
0200		0.37	0.35	0.62	0.52	0.51
0230		0.32	0.33	0.60	0.71	0.50
0300		0.30	0.38	0.50	0.75	0.46
0330		0.28	0.40	0.60	0.68	0.47
0400		0.40	0.39	0.57	0.65	0.47
0430		0.37	0.50	0.47	0.53	0.53
0500		0.38	0.34	0.54	0.60	0.44
0530		0.41	0.36	0.57	0.56	0.44
0600		0.46	0.35	0.52	0.51	0.46
0630		0.52	0.34	0.52	0.60	0.44
0700		0.45	0.46	0.49	0.65	0.58
0730		0.41	0.56	0.75	0.65	0.60
0800	0.20	0.45	0.76	0.83	0.73	0.68
0830	0.16	0.42	0.89	1.00	0.72	0.56
0900		0.43	0.63	0.83	0.68	0.43
0930	0.27	0.40	0.57	0.89	0.56	0.44
1000	0.22	0.59	0.61	0.85	0.87	0.39
1030	0.28	0.48	0.53	0.66	0.51	0.38
1100	0.27	0.52	0.71	0.54	0.50	0.40
1130	0.31	0.29	0.85	0.50	0.66	0.40
1200	0.28	0.45	1.02	0.65	0.47	0.41
1230	0.36	0.52	1.25	0.73	0.60	0.44
1300	0.25	0.47	1.34	0.61	0.53	0.63
1330	0.33	0.37	1.92	0.55	0.52	0.44
1400	0.36	0.38	1.81	0.55	0.59	0.53
1430	0.34	0.36	2.12	0.47	0.58	0.48
1500	0.29	0.55	1.14	0.42	0.57	0.49
1530	0.35	0.30	1.68	0.43	0.71	0.53
1600	0.34	0.35	1.70	0.46	0.54	0.54
1630	0.34	0.35	1.62	0.50	0.68	0.56
1700	0.30	0.33	1.74	0.50	0.52	0.56
1730	0.28	0.49	1.68	0.46	0.54	0.61
1800	0.31	0.37	1.69	0.42	0.50	0.70
1830	0.31	0.33	1.69	0.39	0.60	0.59
1900	0.33	0.37	1.90	0.40	0.50	0.60
1930	0.40	0.43	2.29	0.43	0.52	0.79
2000	0.26	0.40	2.10	0.47	0.56	0.61
2030	0.33	0.34	1.56	0.47	0.60	0.58
2100	0.30	0.47	0.85	0.44	0.73	0.70
2130	0.32	0.36	0.76	0.56	0.54	0.67
2200	0.29	0.43	0.73	0.33	0.53	0.60
2230	0.32	0.37	0.71	0.44	0.39	0.57
2300	0.28	0.39	0.68	0.41	0.39	0.61
2330	0.25	0.38	0.65	0.50	0.47	0.59
2400	0.28	0.43	0.66	0.41	0.44	0.56

Table 30. PAN concentrations in downtown Edmonton, May 1984 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	0.77				0.77	0.40	0.29	0.64
0100	0.63				0.71	0.44	0.31	0.54
0130	0.61				0.71	0.43	0.32	0.52
0200	0.82				0.65	0.42	0.31	0.59
0230	0.63				0.65	0.45	0.30	0.52
0300	0.62				0.66	0.44	0.31	0.58
0330	0.67				0.63	0.47	0.24	0.51
0400	0.65				0.67	0.46	0.25	0.55
0430	0.57				0.65	0.42	0.28	0.43
0500	0.75				0.64	0.40	0.28	0.54
0530	0.53				0.59	0.40	0.26	0.47
0600	0.57				0.56	0.44	0.27	0.48
0630	0.57				0.51	0.40	0.31	0.45
0700	0.54				0.48	0.43	0.28	0.47
0730	0.60				0.59	0.49	0.34	0.53
0800	0.59				0.45	0.44	0.39	0.58
0830	0.61				0.45	0.42	0.39	0.59
0900	0.82				0.43	0.44	0.39	0.67
0930	0.62				0.47	0.42	0.33	0.81
1000	0.66				0.44	0.42	0.35	0.97
1030	0.74				0.46	0.42	0.29	0.80
1100	0.79				0.63	0.42	0.29	0.93
1130	0.82				0.63	0.42	0.34	
1200	0.88				0.87	0.43	0.36	
1230	0.82				0.71	0.40	0.40	0.89
1300	0.88		0.85		0.90	0.42	0.42	0.84
1330	0.89		0.89	0.63	0.61	0.44	0.42	0.81
1400	0.75		0.85	0.66		0.46	0.41	0.75
1430	0.74		0.98	0.65		0.45	0.46	1.10
1500			0.91	0.76	0.52	0.48	0.59	0.90
1530			0.97	0.75	0.51	0.48	0.53	0.82
1600				0.91	0.59	0.49	0.47	0.87
1630				0.79		0.48	0.56	0.85
1700			0.53	0.75		0.46	0.53	0.80
1730			0.71	0.75		0.44	0.45	0.93
1800			0.61	0.85		0.36		0.77
1830				0.99		0.36		0.82
1900				0.91	0.57	0.36		0.72
1930				1.15	0.49	0.30		0.76
2000				0.99	0.52	0.32		0.75
2030				1.06	0.54	0.34		0.74
2100				1.06	0.55	0.30		0.77
2130				1.06	0.57	0.31	0.71	0.78
2200				0.98	0.54	0.32	0.77	0.77
2230				0.83	0.52	0.28	0.66	0.83
2300				0.86	0.40	0.28	0.69	0.77
2330				0.81	0.39	0.30	0.63	0.67
2400				0.85	0.49	0.31	0.61	0.50

continued...

Table 30. Concluded.

Day	9	10	11	12	13	14	15	16
Time								
0030	0.56	0.40	0.35	0.46				
0100	0.62	0.43	0.37	0.50	0.99			
0130	0.61	0.43	0.31	0.45	0.82			
0200		0.44	0.34	0.62	0.72			
0230		0.41	0.33	0.47	0.52			
0300		0.43	0.32	0.48	0.45			
0330		0.37	0.33	0.50	0.36			
0400		0.34	0.33	0.47	0.33			
0430		0.29	0.32	0.54	0.39			
0500		0.23	0.34	0.50	0.34			
0530		0.23	0.34	0.46	0.34			
0600		0.20	0.34	0.48	0.37			
0630		0.21	0.35	0.43	0.35			
0700		0.22	0.33	0.46	0.28			
0730	0.22	0.27	0.40	0.50	0.37			
0800	0.35	0.31	0.40	0.46	0.32			
0830	0.36	0.30	0.39	0.57	0.29			
0900	0.35	0.34	0.39	0.46	0.36			
0930	0.33	0.32	0.42	0.48	0.54			
1000	0.37	0.32	0.40	0.53				
1030	0.33	0.35	0.44			0.51		
1100	0.34	0.34	0.39			0.48		
1130	0.37	0.32	0.44	0.60		0.47		
1200	0.35	0.32	0.37	0.47		0.48		
1230	0.37	0.34	0.39	0.56		0.44		
1300	0.42	0.32	0.43	0.60		0.51		
1330	0.38	0.31	0.51	0.62				
1400	0.40	0.34	0.59	0.93				
1430	0.39	0.36						
1500	0.50	0.41						
1530	0.48	0.28						
1600	0.56							
1630	0.59							
1700	0.57	0.38						
1730	0.56	0.34						
1800	0.53	0.39						
1830	0.58	0.38						
1900	0.56	0.41						
1930	0.56	0.37						
2000	0.64	0.40						
2030	0.67	0.38						
2100	0.44	0.42						
2130	0.43	0.33						
2200	0.47	0.37						
2230	0.51	0.39						
2300	0.49	0.40	0.52					
2330	0.44	0.37	0.53					
2400	0.45	0.31	0.43					

9.2 CONCENTRATIONS OF PAN IN THE FORT SASKATCHEWAN AMBIENT ATMOSPHERE, AUGUST 1983 TO MAY 1984

Table 31. PAN concentrations in the Fort Saskatchewan atmosphere, August 1983 (ppb).

Day	17	18	19	20	21	22	23	24
Time								
0030	0.35							
0100	0.38							
0130	0.37							
0200								
0230								
0300								
0330								
0400								
0430								
0500								
0530								
0600								
0630		<0.27						
0700		<0.27						
0730		<0.27						
0800		<0.27		<0.27				
0830		<0.27		<0.27	<0.27		<0.27	
0900		<0.27	<0.27	<0.27	<0.27	0.35	0.32	<0.27
0930			<0.27	<0.27	<0.27	0.35	0.35	<0.27
1000			<0.27	<0.27	<0.27	0.35	0.33	<0.27
1030		<0.27	<0.27	<0.27	<0.27	0.36	0.34	<0.27
1100		<0.27	<0.27	<0.27	<0.27	0.34	0.33	<0.27
1130		<0.27	<0.27	<0.27	<0.27	0.32	0.32	<0.27
1200		<0.27	<0.27	<0.27	<0.27	0.32	<0.27	<0.27
1230	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1300	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1330		<0.27	0.32	<0.27	<0.27	0.42	<0.27	<0.27
1400		<0.27	0.31	<0.27	<0.27	0.35	<0.27	0.34
1430		<0.27	<0.27	<0.27	<0.27	0.37	<0.27	0.34
1500		<0.27	<0.27	<0.27	<0.27	0.40	<0.27	0.33
1530		<0.27	<0.27	<0.27	<0.27	0.40	<0.27	0.31
1600		<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	0.31
1630		<0.27	<0.27	<0.27	<0.27	0.32	<0.27	0.32
1700		<0.27	<0.27	<0.27	0.32	0.34	<0.27	0.31
1730	<0.27	<0.27	<0.27	<0.27	0.32	0.34	<0.27	0.30
1800	<0.27	<0.27	<0.27	<0.27	0.32	0.33	<0.27	0.30
1830	<0.27	<0.27	0.29	<0.27	0.31	0.32	<0.27	0.31
1900	<0.27	<0.27	<0.27	<0.27	0.31	0.33	<0.27	0.31
1930	<0.27		<0.27	<0.27				0.31
2000	<0.27		<0.27	<0.27				
2030			<0.27					
2100	<0.27							
2130	<0.27							
2200								
2230								
2300								
2330								
2400								

continued...

Table 31. Concluded.

Day	25	26	27	28	29	30	31
Time							
0030							<0.27
0100							0.30
0130							<0.27
0200							0.29
0230							<0.27
0300							<0.27
0330							<0.27
0400							<0.27
0430							<0.27
0500							<0.27
0530							<0.27
0600							<0.27
0630							<0.27
0700							<0.27
0730							<0.27
0800							0.30
0830						<0.27	<0.27
0900		<0.27				0.30	0.32
0930		0.32				<0.27	0.34
1000		0.41					0.31
1030		0.34			0.59		0.27
1100		0.34			0.68	0.31	<0.27
1130		0.33			0.38	0.32	<0.27
1200		0.32			0.35	0.40	<0.27
1230		0.32			0.31	0.35	<0.27
1300		0.32			<0.27	0.33	<0.27
1330	0.33	0.33			<0.27	0.33	<0.27
1400	0.35	0.32			<0.27	0.33	<0.27
1430	0.35	0.32			<0.27	0.33	<0.27
1500	0.36	0.32			<0.27	0.35	<0.27
1530	0.33	0.32			<0.27	0.34	<0.27
1600	0.32	0.32			<0.27	0.34	<0.27
1630	<0.27	0.32			<0.27	0.35	<0.27
1700	<0.27	0.31			<0.27	0.32	<0.27
1730	<0.27	0.31			<0.27	0.33	<0.27
1800	0.29	0.31			<0.27	0.33	<0.27
1830		0.30			<0.27	0.33	<0.27
1900					<0.27	0.33	<0.27
1930					<0.27	0.33	<0.27
2000						0.32	<0.27
2030						0.31	<0.27
2100						0.31	<0.27
2130						0.30	<0.27
2200						0.30	<0.27
2230						<0.27	<0.27
2300						0.29	<0.27
2330						<0.27	<0.27
2400						0.29	<0.27

Table 32. PAN concentrations in the Fort Saskatchewan atmosphere, September 1983 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0100	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0130	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0200	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0230	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0300	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0330	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0400	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0430	<0.27	<0.27	<0.27	<0.27	<0.27	0.28		<0.27
0500	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0530	<0.27	<0.27	<0.27	<0.27	<0.27	0.28		<0.27
0600	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0630	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0700	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0730	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0800	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0830	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0900	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
0930	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27
1000	0.29	<0.27	<0.27	0.29	<0.27	<0.27		<0.27
1030	0.29	<0.27	<0.27	0.32	<0.27	<0.27	<0.27	<0.27
1100	0.29	<0.27	<0.27	0.32	<0.27	<0.27	<0.27	<0.27
1130	0.29	<0.27	<0.27	0.30	<0.27	<0.27	<0.27	<0.27
1200	0.29	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1230	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1300	0.30	0.55	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1330	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1400	<0.27	0.44	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1430	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1500	<0.27	<0.27	<0.27	0.36	<0.27	<0.27	<0.27	<0.27
1530	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1600	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
1630	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
1700	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
1730	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
1800	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
1830	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
1900	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
1930	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2000	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2030	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2100	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2130	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2200	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2230	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2300	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2330	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27
2400	<0.27	<0.27	<0.27	<0.27	<0.27		<0.27	<0.27

continued...

Table 32. Concluded.

Day	9	10	11	12	13	14	15	16
Time								
0030	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0100	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0130	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0200	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0230	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0300	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0330	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0400	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0430	<0.27	<0.27	0.29	0.28	<0.27	<0.27	<0.27	<0.27
0500	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0530	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0600	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0630	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0700	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0730	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0800	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0830	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
0900	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
0930	<0.27	0.33	<0.27	<0.27	<0.27	<0.27	<0.27	
1000	<0.27	0.30	<0.27	<0.27	<0.27	<0.27	<0.27	
1030	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1100		<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1130		<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1200		<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1230		<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1300		<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1330		<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1400	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1430	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	0.29	
1500	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	0.30	
1530	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	0.29	
1600	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	0.29	
1630	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1700	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1730	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1800	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1830	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1900	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
1930	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2000	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2030	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2100	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2130	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2200	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2230	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2300	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2330	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	
2400	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	

Table 33. PAN concentrations in the Fort Saskatchewan atmosphere, April 1984 (ppb).

Day	17	18	19	20	21	22	23	24
Time								
0030		0.21	<0.15	<0.15	0.53	0.17	0.23	0.22
0100		0.21	<0.15	<0.15	0.52	0.18	0.18	0.22
0130		0.21	<0.15	<0.15	0.50	0.16	0.18	0.24
0200		0.20	<0.15	<0.15	0.47	0.17	0.18	0.22
0230		0.20	<0.15	<0.15	0.43	0.16	0.18	0.21
0300		0.20	<0.15	<0.15	0.45	0.16	0.17	0.21
0330		0.19	<0.15	<0.15	0.44	0.15	0.18	0.21
0400		0.20	<0.15	<0.15	0.41	0.16	0.17	0.21
0430		0.19	<0.15	<0.15	0.36	0.16	0.18	0.21
0500		0.19	<0.15	<0.15	0.35	0.17	0.16	0.21
0530		0.18	<0.15	<0.15	0.32	0.16	0.16	0.21
0600		0.19	<0.15	<0.15	0.30	0.16	0.18	0.21
0630		0.19	<0.15	<0.15	0.30	0.15	0.18	0.21
0700		0.19	<0.15		0.38	0.16	0.18	0.21
0730		0.20	<0.15		0.46	0.16	0.18	0.21
0800		0.21	<0.15		0.50	0.17	0.19	0.22
0830		0.21	<0.15		0.45	0.17	0.18	0.24
0900		0.23	<0.15		0.51	0.16	0.18	0.24
0930		0.23	<0.15		0.52	0.16	0.18	0.23
1000		0.22	<0.15		0.52	0.19	0.18	0.22
1030		0.24	<0.15		0.56	0.18	0.18	0.24
1100		0.24	<0.15	0.25	0.57	0.18	0.19	0.24
1130		0.24	<0.15	0.27	0.51	0.18	0.23	0.25
1200		0.29	<0.15	0.46	0.53	0.18	0.23	0.24
1230		0.27	<0.15	0.45	0.75	0.19	0.24	0.24
1300		0.29	0.15	0.48	0.67	0.19	0.24	0.25
1330	0.32	0.27	0.15	0.45	0.66	0.20	0.25	0.25
1400	0.36	0.27	0.15	0.45	0.58	0.20	0.25	0.24
1430	0.30	0.27	0.15	0.48	0.49	0.21	0.25	0.24
1500	0.37	0.29	0.17	0.50	0.44	0.21	0.26	0.24
1530	0.35	0.30	0.16	0.49	0.45	0.21	0.24	0.24
1600	0.20	0.38	0.17	0.48	0.48	0.24	0.24	0.25
1630	0.55	0.33	0.17	0.46	0.38	0.22	0.24	0.26
1700	0.30	0.30	0.18	0.48	0.32	0.22	0.24	0.26
1730	0.27	0.27	0.20	0.44	0.35	0.22	0.24	0.26
1800	0.30	0.26	0.18	0.45	0.39	0.23	0.23	0.25
1830	0.29	0.22	0.18	0.47	0.35	0.23	0.24	0.26
1900	0.25	0.18	0.19	0.47	0.35	0.23	0.24	0.24
1930	0.26	0.20	0.20	0.48	0.27	0.24	0.23	0.25
2000	0.25	0.18	0.18	0.48	0.19	0.24	0.21	0.24
2030	0.23	0.18	0.16	0.51	0.17	0.23	0.21	0.23
2100	0.22	0.18	0.17	0.56	0.16	0.22	0.21	0.22
2130	0.21	0.18	0.17	0.57	0.15	0.22	0.21	0.21
2200	0.21	0.17	0.17	0.62	0.17	0.22	0.21	0.21
2230	0.21	0.17	0.17	0.60	0.17	0.21	0.21	0.21
2300	0.21	0.16	0.16	0.62	0.17	0.21	0.21	0.21
2330	0.20	<0.15	0.15	0.57	0.18	0.21	0.22	0.22
2400	0.21	<0.15	<0.15	0.54	0.17	0.20	0.23	0.23

continued...

Table 33. Concluded.

Day	25	26	27	28	29	30
Time						
0030	0.18	0.18	0.21	0.32	0.24	0.23
0100	0.17	0.18	0.20	0.33	0.24	0.22
0130	<0.15	0.17	0.21	0.32	0.24	0.24
0200	<0.15	0.17	0.17	0.29	0.26	0.22
0230	<0.15	0.19	0.21	0.27	0.30	0.20
0300	<0.15	0.21	0.17	0.25	0.27	0.18
0330	<0.15	0.21	0.15	0.24	0.27	0.20
0400	<0.15	0.21	0.18	0.23	0.27	0.21
0430	<0.15	0.21	0.17	0.23	0.24	0.20
0500	<0.15	0.20	0.16	0.21	0.26	0.24
0530	<0.15	0.21	0.18	0.17	0.24	0.25
0600	<0.15	0.20	0.18	0.20	0.26	0.29
0630	<0.15	0.21	0.18	0.23	0.27	0.24
0700	<0.15	0.21	0.23	0.36	0.29	0.25
0730	<0.15	0.21	0.25	0.42	0.30	0.29
0800	0.15	0.21	0.30	0.46	0.33	0.33
0830	0.16	0.22	0.35	0.52	0.33	0.30
0900	0.18	0.24	0.32	0.54	0.33	0.23
0930	0.18	0.24	0.29	0.54	0.33	0.22
1000	0.15	0.25	0.29	0.44	0.30	0.22
1030	0.18	0.24	0.27	0.38	0.30	0.24
1100	<0.15	0.24	0.27	0.36	0.30	0.24
1130		0.26	0.29	0.35	0.32	0.24
1200		0.25	0.27	0.33	0.32	0.26
1230		0.24	0.32	0.30	0.36	0.24
1300		0.24	0.32	0.29	0.33	0.25
1330	0.25	0.23	0.32	0.29	0.33	0.27
1400	0.24	0.22	0.33	0.27	0.30	0.27
1430	0.23	0.22	0.33	0.27	0.30	0.29
1500	0.23	0.21	0.35	0.32	0.30	0.29
1530	0.20	0.20	0.38	0.32	0.30	0.29
1600	0.27	0.18	0.39	0.30	0.29	0.32
1630	<0.15	0.21	0.41	0.27	0.27	0.32
1700	0.21	0.21	0.43	0.25	0.27	0.33
1730	0.21	0.21	0.44	0.25	0.27	0.32
1800	0.21	0.23	0.42	0.24	0.27	0.32
1830	0.21	0.22	0.43	0.24	0.27	0.33
1900	0.21	0.24	0.44	0.23	0.26	0.36
1930	0.21	0.23	0.36	0.24	0.25	0.38
2000	0.22	0.23	0.35	0.24	0.22	0.35
2030	0.21	0.23	0.35	0.24	0.22	0.35
2100	0.20	0.21	0.35	0.27	0.24	0.33
2130	0.21	0.22	0.30	0.30	0.20	0.30
2200	0.18	0.21	0.30	0.30	0.19	0.30
2230	0.17	0.21	0.32	0.27	0.20	0.30
2300	0.18	0.21	0.32	0.26	0.20	0.29
2330	0.21	0.21	0.32	0.27	0.19	0.30
2400	0.19	0.21	0.32	0.27	0.22	0.32

Table 34. PAN concentrations in the Fort Saskatchewan atmosphere, May 1984 (ppb).

Day	1	2	3	4	5	6	7	8
Time								
0030	0.32	0.41	0.32	0.20	0.33			
0100	0.33	0.40	0.29	0.21	0.36			
0130	0.33	0.38	0.27	0.22	0.35			
0200	0.33	0.35	0.26	0.21	0.33			
0230	0.35	0.33	0.26	0.20	0.36			
0300	0.37	0.32	0.25	0.21	0.33			
0330	0.40	0.33	0.26	0.21	0.32			
0400	0.39	0.32	0.25	0.21	0.30			
0430	0.37	0.30	0.25	0.21	0.27			
0500	0.38	0.32	0.29	0.20	0.27			
0530	0.38	0.33	0.35	0.18	0.27			
0600	0.33	0.33	0.35	0.17	0.27			
0630	0.32	0.33	0.38	0.15	0.26			
0700	0.36	0.33	0.36	0.18				
0730	0.35	0.33	0.38	0.21				
0800	0.36	0.35	0.32	0.25				
0830	0.35	0.38	0.33	0.27				
0900	0.33	0.38	0.35	0.29				
0930	0.37	0.40	0.38	0.30				
1000	0.39	0.42	0.39	0.33				
1030	0.41	0.41	0.40	0.35				
1100	0.41	0.43	0.46	0.45				
1130	0.43	0.44	0.49	0.41				
1200	0.44	0.47	0.50	0.41				
1230	0.46	0.50	0.52	0.41				
1300	0.49	0.65	0.54	0.42				
1330	0.52	0.54	0.57	0.46				
1400	0.51	0.47	0.55					
1430	0.53	0.52	0.52					
1500	0.50	0.48	0.53	0.37				
1530	0.49	0.45	0.56	0.35				
1600	0.48	0.42	0.56	0.40				
1630	0.46	0.44	0.44	0.41				
1700	0.46	0.44	0.48	0.42				
1730	0.44	0.42	0.60	0.41				
1800	0.44	0.43	0.48	0.39				
1830	0.45	0.45	0.48	0.40				
1900	0.46	0.44	0.46	0.40				
1930	0.47	0.44	0.42	0.45				
2000	0.48	0.44	0.60	0.57				
2030	0.47	0.42	0.41	0.54				
2100	0.48	0.38	0.32	0.54				
2130	0.49	0.36	0.32	0.41				
2200	0.50	0.33	0.29	0.37				
2230	0.46	0.33	0.29	0.35				
2300	0.44	0.37	0.29	0.38				
2330	0.43	0.35	0.24	0.39				
2400	0.42	0.33	0.22	0.38				

9.3 MAJOR IONS IN THE EDMONTON ATMOSPHERE, NOVEMBER 1982 TO OCTOBER 1983

Table 35. Major ions in the Edmonton atmosphere, November 1982 (0930 0930) - total of teflon and nylon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	3.16	2.96		1.89	1.09	0.89	0.34	4.07	0.30
2	1.47	1.84		1.52	0.34	0.33	0.12	1.77	0.18
3	0.84	0.94		0.78	0.31	0.20	0.13	1.51	0.18
4	1.13	0.55		1.05	0.70	0.09	0.17	1.61	0.20
5	0.98	0.81		1.44	0.77	0.12	0.21	2.21	0.23
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Table 36. Major ions in the Edmonton atmosphere, November 1982 (0930 0930) - nylon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.86	0.53		0.06	0.06	0.03	0.03	0.36	0.08
2	0.57	0.20		0.53	0.08	0.01	0.03	0.25	0.06
3	0.19	0.15		0.44	0.04	0.01	0.02	0.16	0.04
4	0.20	0.18		0.53	0.06	0.00	0.00	0.53	0.09
5	0.40	0.18		0.91	0.27	0.00	0.11	0.36	0.07
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Table 37. Major ions in the Edmonton atmosphere, November 1982 (0930 0930) - teflon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	2.30	2.43		1.23	1.03	0.86	0.31	3.71	0.22
2	0.90	1.64		0.99	0.26	0.32	0.10	1.52	0.12
3	0.64	0.79		0.34	0.28	0.19	0.12	1.35	0.15
4	0.93	0.38		0.52	0.64	0.09	0.17	1.08	0.12
5	0.57	0.63		0.53	0.50	0.12	0.11	1.85	0.16
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

Table 38. Major ions in the Edmonton atmosphere, November 1982 (0000 2400) - total of teflon and nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2									
3									
4									
5									
6	2.46	3.13		1.03	0.39	0.55	0.18	3.47	0.19
7	1.15	0.93		0.11	0.58	0.75	0.26		
8	1.16	1.23		0.13	0.22	0.91	0.06	0.93	0.16
9	1.15	1.36		0.16		0.80			
10	0.86	0.74		0.22	0.72	0.22	0.86		
11	0.62	0.53		0.25	0.51	0.22	0.62		
12	1.00	1.06		0.25	1.04	0.35	0.99	1.76	0.27
13	0.86	0.86		0.26	0.85	0.21	0.85		
14	0.50	0.58		0.24	0.56	0.14	0.49	2.36	0.28
15	0.54	0.69		0.38	0.67	0.14	0.53	2.11	0.40
16	1.10	0.85		0.24	0.84		1.09	1.36	0.14
17	3.32	1.81		1.89	1.79	1.45	3.35	0.77	0.10
18	2.12	0.71		0.22	0.69	0.48	2.12	0.66	0.11
19	0.83	0.19		0.36	0.17	0.32	0.82	0.33	0.08
20	0.91	0.38		1.53	0.37	0.63	0.90	1.04	0.16
21	0.74	0.50		1.11	0.48	0.58	0.73	0.46	0.09
22	0.57	0.55		0.75	0.54	0.46	0.86	1.06	0.12
23	0.84	0.90		0.65	0.89	0.63	0.83	0.80	0.10
24	3.02	1.84		1.00	1.82	6.54	3.02	0.93	0.11
25	2.84	3.13		0.86	3.11	6.54	2.44	0.93	0.09
26	1.91	0.38		0.87	0.37	3.10	1.90	1.06	0.18
27	2.71	3.57		1.11	3.56	6.94	2.70	0.96	0.17
28	2.37	4.34		0.92	4.32	6.70	2.36	0.52	0.09
29	3.13	4.67		1.01	4.66	11.7	3.13	0.94	0.11
30	3.26	4.62		1.03	4.60	12.7	3.28	0.69	0.06

Table 39. Major ions in the Edmonton atmosphere, November 1982 (0000 2400) - nylon filters. (All values given in $\mu g/m^3$.)

	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
Day									
1									
2									
3									
4									
5									
6	0.78	0.29		0.45	0.03	0.01	0.03	0.06	0.02
7	0.50	0.14		0.00	0.15	0.02	0.04	0.18	0.03
8	0.49	0.16		0.00	0.04	0.00	0.02	0.25	0.06
9	0.52	0.16		0.00	0.13	0.00	0.11	0.42	0.08
10	0.41	0.17		0.00	0.16	0.02	0.42		
11	0.26	0.13		0.00	0.11	0.02	0.27	0.07	0.01
12	0.41	0.13		0.00	0.12	0.00	0.42	0.16	0.03
13	0.33	0.17		0.00	0.16	0.01	0.34	0.21	0.03
14	0.19	0.23		0.00	0.22	0.01	0.20	0.13	0.03
15	0.20	0.18		0.00	0.17	0.04	0.21	0.18	0.03
16	0.46	0.06		0.00	0.05		0.47	0.11	0.02
17	0.98	0.18		1.38	0.17	0.01	0.99	0.16	0.02
18	0.78	0.21		0.00	0.20	0.03	0.80	0.17	0.04
19	0.48	0.10		0.30	0.09	0.02	0.49	0.17	0.05
20	0.19	0.10		0.47	0.09	0.00	0.20	0.44	0.12
21	0.22	0.39		0.34	0.38	0.00	0.23	0.11	0.01
22	0.26	0.00		0.40	0.00	0.00	0.27	0.16	0.03
23	0.45	0.00		0.36	0.00	0.00	0.46	0.19	0.02
24	0.55	0.10		0.26	0.09	0.02	0.56	0.08	0.01
25	0.54	0.14		0.37	0.13	0.02	0.15	0.13	0.02
26	0.31	0.15		0.40	0.15	0.00	0.32	0.33	0.08
27	0.74	0.17		0.40	0.16	0.01	0.75	0.32	0.05
28	0.56	0.16		0.32	0.15	0.01	0.57	0.13	0.02
29	0.70	0.12		0.23	0.11	0.01	0.71	0.13	0.01
30	0.61	0.11		0.26	0.10	0.03	0.63	0.07	0.01

Table 40. Major ions in the Edmonton atmosphere, November 1982 (0000 2400) - teflon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2									
3									
4									
5									
6	1.68	2.84		0.58	0.36	0.53	0.16	3.41	0.17
7	0.65	0.79		0.14	0.43	0.73	0.23		
8	0.67	1.07		0.13	0.18	0.91	0.04	0.68	0.10
9	0.63	1.20		0.16		0.80			
10	0.45	0.56		0.22	0.56	0.20	0.44	1.31	0.20
11	0.36	0.41		0.25	0.40	0.20	0.35		
12	0.59	0.93		0.25	0.92	0.35	0.57	1.60	0.25
13	0.53	0.70		0.26	0.69	0.20	0.51		
14	0.31	0.35		0.24	0.34	0.13	0.29	2.23	0.25
15	0.33	0.51		0.38	0.50	0.10	0.32	1.93	0.37
16	0.63	0.80		0.24	0.79	0.59	0.62	1.25	0.12
17	2.37	1.63		0.52	1.62	1.35	2.36	0.61	0.08
18	1.34	0.50		0.02	0.49	0.45	1.32	0.49	0.07
19	0.35	0.09		0.06	0.08	0.30	0.33	0.17	0.03
20	0.71	0.28		1.06	0.28	0.63	0.70	0.60	0.04
21	0.51	0.11		0.78	0.10	0.58	0.50	0.35	0.08
22	0.31	0.55		0.35	0.54	0.46	0.59	0.91	0.09
23	0.39	0.90		0.29	0.89	0.63	0.38	0.61	0.09
24	2.47	1.74		0.73	1.73	6.34	2.46	0.85	0.11
25	2.30	2.99		0.49	2.98	6.34	2.29	0.80	0.08
26	1.60	0.23		0.47	0.22	3.10	1.58	0.74	0.10
27	1.97	3.40		0.71	3.40	6.93	1.95	0.65	0.12
28	1.81	4.18		0.61	4.18	6.69	1.79	0.40	0.08
29	2.43	4.55		0.78	4.55	11.7	2.42	0.81	0.10
30	2.66	4.51		0.77	4.51	12.7	2.65	0.62	0.06

Table 41. Major ions in the Edmonton atmosphere, December 1982 (0000 2400) - total of teflon and nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	1.65	2.31		0.26	0.59	4.13	0.34	0.78	0.10
2	1.43	1.36		0.14	0.23	2.19	0.05	0.52	0.08
3	1.31	0.54		0.15	0.38	0.72	0.20	0.89	0.09
4	1.44	0.82		0.58	0.54	0.94	0.23	0.72	0.09
5	0.68	0.39		1.29	1.88	0.15	0.17	0.67	0.11
6	2.37	1.74		1.45	2.69		0.13	1.60	0.14
7	1.66	1.00		1.89	0.17	0.39	0.06	1.05	0.11
8	1.71	1.67		2.05	2.62	0.27	0.07	1.92	0.17
9	0.98	0.44		1.98	1.70	0.03	0.06	1.02	0.09
10	2.38	1.95		2.13	2.77	0.63	0.20	1.33	0.15
11	2.18	3.98		1.98	2.09	1.83	0.08	1.44	0.16
12	3.66	4.70		1.82	1.92	1.69	0.14	4.06	0.18
13	3.48	4.01		1.69	0.79	2.92	0.29	0.81	0.10
14	2.70	2.33		1.46	0.53	0.90	0.26	0.79	0.09
15	3.39	5.62		1.13	0.45	0.01	0.19	0.12	0.05
16	0.35	0.23		0.76	0.31	0.00	0.09	0.40	0.04
17	0.43	0.34		1.32	0.57	0.00	0.23	0.84	0.08
18	0.38	0.27		0.85	0.29	0.00	0.08	0.48	0.05
19	4.47	4.93		1.75	0.99	2.34	0.37	3.31	0.29
20	6.01	8.30		2.21	2.50	8.42	0.61	11.9	0.54
21	3.73	0.82		0.59	0.15	1.70	0.02	0.39	0.04
22	2.42	0.42		0.63	0.10	0.55	0.01	0.33	0.04
23	3.45	1.56		1.02	0.42	1.01	0.14	1.12	0.09
24	2.96	2.04		1.01	0.26	1.19	0.04	0.58	0.07
25	0.53	0.78		1.03	0.35	0.01	0.03	0.35	0.06
26	0.67	0.43		1.11	0.47	0.14	0.05	0.39	0.06
27	0.77	0.31		0.82	0.27	0.02	0.05	0.31	0.03
28	0.80	0.54		1.62	0.42	0.00	0.11	0.66	0.09
29	0.95	0.44		0.96	0.28	0.00	0.04	0.67	0.08
30	0.68	0.55		1.04	0.27	0.01	0.04	1.10	0.08
31	1.02	0.56		1.22	3.98	0.00	0.10	1.19	0.16

Table 42. Major ions in the Edmonton atmosphere, December 1982 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.58	0.20		0.00	0.21	0.06	0.17	0.08	0.02
2	0.57	0.14		0.00	0.08	0.05	0.03	0.22	0.04
3	0.56	0.11		0.00	0.17	0.01	0.03	0.16	0.02
4	0.66	0.10		0.32	0.14	0.02	0.04	0.16	0.01
5	0.31	0.10		0.25	0.09	0.01	0.01	0.11	0.02
6	0.64	0.18		0.00	0.14		0.06	0.11	0.01
7	0.24	0.15		0.53	0.08	0.00	0.01	0.06	0.01
8	0.41	0.16		0.64	0.09	0.00	0.04	0.17	0.03
9	0.34	0.14		0.69	0.16	0.00	0.02	0.15	0.02
10	0.63	0.15		0.79	0.26	0.00	0.04	0.30	0.04
11	0.00	0.16		0.64	0.08	0.00	0.01	0.11	0.02
12	0.59	0.15		0.53	0.05	0.00	0.03	0.10	0.01
13	1.05	0.15		0.61	0.18	0.00	0.16	0.07	0.01
14	1.06	0.14		0.52	0.06	0.00	0.03	0.07	0.01
15	0.21	0.11		0.53	0.06	0.00	0.10	0.08	0.01
16	0.24	0.13		0.55	0.14	0.00	0.06	0.20	0.02
17	0.17	0.13		0.57	0.15	0.00	0.13	0.20	0.04
18	0.17	0.13		0.56	0.08	0.00	0.04	0.15	0.02
19	2.02	0.28		0.51	0.14	0.01	0.11	0.07	0.00
20	1.32	0.22		0.82	0.26	0.00	0.25	0.43	0.05
21	0.85	0.10		0.38	0.01	0.07	0.01	0.04	0.00
22	0.58	0.14		0.47	0.01	0.00	0.01	0.05	0.01
23	0.77	0.15		0.58	0.15	0.00	0.04	0.07	0.00
24	0.84	0.17		0.54	0.05	0.00	0.01	0.08	0.01
25	0.19	0.14		0.10	0.00	0.00	0.00	0.03	0.01
26	0.22	0.13		0.57	0.06	0.00	0.04	0.11	0.02
27	0.43	0.14		0.57	0.08	0.00	0.05	0.12	0.01
28	0.49	0.15		0.62	0.13	0.00	0.08	0.14	0.04
29	0.65	0.15		0.60	0.10	0.00	0.01	0.24	0.03
30	0.37	0.41		0.59	0.01	0.01	0.00	0.05	0.01
31	0.30	0.14		0.67	0.13	0.00	0.00	0.07	0.01

Table 43. Major ions in the Edmonton atmosphere, December 1982 (0000 2400) - teflon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	1.07	2.11		0.26	0.38	4.07	0.14	0.71	0.08
2	0.86	1.22		0.14	0.15	1.69	0.02	0.30	0.04
3	0.76	0.43		0.15	0.21	0.71	0.17	0.73	0.07
4	0.79	0.72		0.26	0.50	0.92	0.19	0.56	0.08
5	0.37	0.30		1.04	1.79	0.14	0.16	0.56	0.09
6	1.73	1.56		1.45	2.55	0.49	0.07	1.49	0.13
7	1.42	0.86		1.36	0.09	0.39	0.05	0.99	0.10
8	1.30	1.51		1.41	2.53	0.27	0.03	1.75	0.14
9	0.64	0.30		1.29	1.54	0.03	0.04	0.87	0.07
10	1.75	1.80		1.34	1.91	0.63	0.16	1.03	0.11
11	2.18	3.82		1.34	2.01	1.83	0.07	1.33	0.14
12	3.07	4.55		1.29	1.87	1.69	0.11	3.96	0.17
13	2.43	3.86		1.08	0.51	2.92	0.13	0.74	0.09
14	1.64	2.19		0.94	0.47	0.90	0.23	0.72	0.08
15	3.18	5.51		0.60	0.39	0.01	0.09	0.40	0.04
16	0.11	0.11		0.21	0.17	0.00	0.03	0.20	0.02
17	0.26	0.21		0.75	0.42	0.00	0.10	0.64	0.04
18	0.21	0.14		0.29	0.21	0.00	0.04	0.33	0.03
19	2.45	4.65		1.24	0.85	2.33	0.26	3.24	0.29
20	4.69	8.08		1.39	2.24	8.42	0.36	11.5	0.49
21	2.88	0.72		0.21	0.14	1.63	0.01	0.35	0.04
22	1.84	0.29		0.16	0.09	0.55	0.00	0.18	0.03
23	2.68	1.41		0.44	0.27	1.01	0.10	1.05	0.09
24	2.12	1.87		0.47	0.21	1.19	0.03	0.50	0.06
25	0.34	0.64		0.93	0.35	0.01	0.03	0.32	0.05
26	0.45	0.30		0.54	0.41	0.14	0.01	0.28	0.04
27	0.35	0.18		0.25	0.19	0.02	0.00	0.19	0.02
28	0.31	0.39		1.00	0.29	0.00	0.03	0.52	0.05
29	0.31	0.29		0.36	0.18	0.00	0.03	0.43	0.05
30	0.31	0.15		0.45	0.26	0.00	0.04	1.05	0.07
31	0.72	0.43		1.55	3.85	0.00	0.10	1.12	0.15

Table 44. Major ions in the Edmonton atmosphere, January 1983 (0000 2400) - total of teflon and nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	1.04	1.05		2.00	4.04	0.03	0.14	1.46	0.20
2	1.87	2.51		1.91	0.66	0.93	0.02	0.30	0.04
3	1.06	1.36		1.10	0.31	0.47	0.05	0.29	0.05
4	0.45	0.53		1.90	2.26	0.01	0.09	0.53	0.06
5	0.95	1.37		2.12	2.90	0.07	0.10	1.25	0.18
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21	2.47	0.70		0.85	0.29	0.52	0.04	0.73	0.11
22	4.12	1.62		0.93	0.27	0.89	0.02	0.45	0.11
23	1.79	0.26		1.81	0.15	0.37	0.14	0.18	0.06
24	1.36	0.64		1.59	0.29	0.45	0.26	0.23	0.08
25	1.40	0.85		1.16	0.17	0.52	0.16	0.23	0.06
26									
27	2.68	2.76		1.59	0.39	1.47	0.35	0.66	0.09
28	3.02	4.84		1.58	0.50	3.54	0.48	1.61	0.12
29	1.19	2.81		1.93	0.27	0.76	0.26	0.17	0.03
30	1.70	4.38		1.65	0.70	1.50	0.69	0.21	0.04
31	1.26	2.02		1.47	0.44	0.62	0.44	0.97	0.08

Table 45. Major ions in the Edmonton atmosphere, January 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.40	0.11		0.42	0.05	0.00	0.08	0.00	0.00
2	0.77	0.13		0.93	0.03	0.00	0.01	0.08	0.01
3	0.32	0.11		0.57	0.03	0.00	0.02	0.10	0.01
4	0.28	0.14		0.59	0.46	0.00	0.05	0.09	0.01
5	0.28	0.16		0.60	0.07	0.00	0.05	0.14	0.03
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21	0.60	0.10		0.48	0.04	0.00	0.01	0.07	0.01
22	2.05	1.24		0.65	0.06	0.00	0.01	0.08	0.01
23	0.21	0.09		0.70	0.01	0.00	0.01	0.01	0.01
24	0.14	0.11		0.70	0.03	0.00	0.01	0.00	0.01
25	0.14	0.13		0.65	0.00	0.00	0.00	0.03	0.01
26									
27	0.37	0.13		0.59	0.04	0.00	0.01	0.04	0.00
28	2.39	0.17		0.58	0.02	0.03	0.01	0.03	0.01
29	0.43	0.12		0.72	0.00	0.00	0.00	0.00	0.00
30	0.43	0.14		0.51	0.00	0.02	0.00	0.01	0.00
31	0.57	0.13		0.51	0.00	0.00	0.01	0.05	0.00

Table 46. Major ions in the Edmonton atmosphere, January 1983 (0000 2400) - teflon filters. (All values given in μg/m³.)

	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
Day									
1	0.64	0.94		1.58	3.99	0.03	0.06	1.46	0.20
2	1.10	2.38		0.98	0.63	0.93	0.01	0.22	0.03
3	0.74	1.25		0.53	0.28	0.47	0.03	0.19	0.04
4	0.17	0.39		1.31	1.80	0.01	0.04	0.44	0.05
5	0.67	1.21		1.52	2.83	0.07	0.05	1.11	0.15
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21	1.87	0.60		0.37	0.25	0.52	0.03	0.66	0.10
22	2.07	0.38		0.28	0.21	0.89	0.01	0.37	0.10
23	1.58	0.17		1.11	0.14	0.37	0.13	0.17	0.05
24	1.22	0.53		0.89	0.26	0.45	0.25	0.23	0.07
25	1.26	0.73		0.51	0.17	0.52	0.16	0.20	0.05
26									
27	2.31	2.63		1.00	0.35	1.47	0.34	0.62	0.09
28	0.63	4.67		1.00	0.48	3.51	0.47	1.58	0.11
29	0.76	2.69		1.21	0.27	0.76	0.26	0.17	0.03
30	1.27	4.24		1.14	0.70	1.48	0.69	0.20	0.04
31	0.69	1.89		0.96	0.44	0.62	0.43	0.92	0.08

Table 47. Major ions in the Edmonton atmosphere, January 1983 (1300 1300) - total of teflon and nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2									
3									
4									
5									
6	1.84	4.11		1.93	2.41	1.15	0.06	0.93	0.12
7	0.21	0.29		1.56	0.63	0.00	0.05	0.39	0.06
8	0.55	0.33		1.09	2.58	0.00	0.08	2.02	0.18
9	0.99	0.76		2.01	2.36	0.10	0.05	1.18	0.17
10	4.11	1.90		1.67	0.92	0.38	0.05	0.70	0.14
11	2.73	2.08		2.15	3.11	0.45	0.15	1.81	0.21
12	0.80	0.40		1.93	1.59	0.00	0.09	1.64	0.13
13	0.52	0.69		2.12	2.08	0.00	0.26	1.47	0.19
14	0.45	0.55		1.44	0.70	0.03	0.08	0.41	0.35
15	0.15	0.20		0.98	0.33	0.00	0.02	0.25	0.28
16	1.30	0.98		1.69	1.48	0.18	0.05	0.74	0.12
17	2.03	4.57		1.90	2.17	1.48	0.12	2.56	0.45
18	2.50	4.90		1.87	1.82	1.88	0.09	1.75	0.23
19	1.31	2.19		1.51	0.53	0.97	0.03	0.56	0.07
20	4.69	6.45		1.86	1.70	3.98	0.09	2.06	0.27
21									
22									
23									
24									
25									
26	0.61	0.43		1.11	0.09	0.15	0.08	0.11	0.02
27									
28									
29									
30									
31									

Table 48. Major ions in the Edmonton atmosphere, January 1983 (1300 1300) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2									
3									
4									
5									
6	0.48	0.13		0.52	0.02	0.01	0.01	0.05	0.01
7	0.10	0.10		0.63	0.09	0.00	0.04	0.11	0.02
8	0.19	0.14		0.62	0.07	0.00	0.02	0.14	0.04
9	0.37	0.13		0.56	0.05	0.00	0.01	0.07	0.02
10	2.66	1.34		0.50	0.06	0.00	0.02	0.07	0.01
11	0.89	0.15		0.63	0.11	0.02	0.01	0.12	0.02
12	0.41	0.14		0.57	0.10	0.00	0.02	0.07	0.02
13	0.51	0.13		0.65	4.49	0.00	0.14	0.07	0.01
14	0.22	0.11		0.55	0.11	0.00	0.03	0.07	0.01
15	0.06	0.10		0.52	0.04	0.00	0.01	0.09	0.02
16	0.41	0.13		0.40	0.15	0.00	0.01	0.03	0.00
17	0.34	0.13		0.53	0.02	0.01	0.01	0.04	0.01
18	0.53	0.14		0.49	0.04	0.00	0.03	0.06	0.01
19	0.40	0.10		0.60	0.05	0.00	0.02	0.09	0.01
20	1.08	0.21		0.56	0.11	0.00	0.00	0.20	0.03
21									
22									
23									
24									
25									
26	0.22	0.19		0.80	0.00	0.00	0.00	0.04	0.00
27									
28									
29									
30									
31									

Table 49. Major ions in the Edmonton atmosphere, January 1983 (1300 1300) - teflon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2									
3									
4									
5									
6	1.37	3.98		1.41	2.39	1.14	0.05	0.88	0.11
7	0.11	0.18		0.93	0.54	0.00	0.01	0.28	0.04
8	0.36	0.19		0.47	2.51	0.00	0.06	1.88	0.14
9	0.62	0.63		1.45	2.31	0.10	0.04	1.11	0.15
10	1.45	0.56		1.17	0.86	0.38	0.63	0.63	0.13
11	1.84	1.93		1.52	3.00	0.44	0.14	1.69	0.19
12	0.39	0.73		1.36	1.49	0.00	0.07	1.57	0.11
13	0.36	0.56		1.47	2.59	0.00	0.12	1.40	0.18
14	0.23	0.44		0.89	0.59	0.03	0.05	0.34	0.34
15	0.09	0.10		0.46	0.29	0.00	0.01	0.16	0.26
16	0.89	0.84		1.29	1.23	0.18	0.04	0.71	0.12
17	1.69	4.44		1.37	2.15	1.47	0.11	2.52	0.44
18	1.97	4.76		1.38	1.78	1.88	0.06	1.69	0.23
19	0.91	2.09		0.91	0.48	0.97	0.01	0.47	0.06
20	3.69	6.24		1.30	1.59	3.98	0.09	1.86	0.24
21									
22									
23									
24									
25									
26	0.38	0.25		0.31	0.09	0.15	0.08	0.07	0.02
27									
28									
29									
30									
31									

Table 50. Major ions in the Edmonton atmosphere, February 1983 (0000 2400) - total of teflon and nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	3.10	2.73		1.36	0.34	1.77	0.05	0.30	0.04
2	3.33	2.64		0.89	0.30	1.81	0.00	0.42	0.04
3	2.67	1.63		0.79	0.30	1.00	0.01	0.21	0.04
4	2.70	1.67		0.84	0.32	1.44	0.04	0.21	0.06
5	2.80	3.60		1.70	1.09	1.88	0.07	0.65	0.12
6	5.69	5.51		1.97	4.33		0.05	0.70	0.12
7	1.48	0.99		1.11	0.51	0.46	0.00	0.20	0.02
8	2.65	3.29		2.05	2.67	1.37	0.04	0.91	0.13
9	3.94	4.49		1.98	1.90	3.05	0.06	0.75	0.14
10	3.51	4.94		1.44	1.06	3.17	0.05	0.47	0.07
11	2.57	4.09		1.86	2.70	1.62	0.03	0.60	0.07
12	1.66	4.67		1.67	1.92	1.62	0.03	0.43	0.06
13	1.25	3.88		1.86	1.98	0.94	0.08	0.59	0.08
14	0.71	1.88		2.29	6.48	0.86	0.07	1.37	0.13
15	2.12	2.07		2.03	5.14	0.46	0.07	1.28	0.09
16	1.51	0.48		1.62	1.19	0.53	0.00	0.68	0.11
17	1.66	0.73		1.62	1.23	0.57	0.13	0.77	0.11
18	2.51	2.69		1.80	2.19	1.24	0.04	1.39	0.21
19	2.28	2.10		1.79	1.65	0.91	0.02	0.62	0.09
20	3.19	5.00		2.15	4.58	1.89	0.04	2.11	0.25
21	1.17	0.97		1.99	2.62	0.14	0.08	1.54	0.20
22	1.00	3.64		1.86	1.63	0.68	0.30	1.13	0.16
23	1.28	1.87		0.71	0.24	0.53	0.00	0.37	0.05
24	1.60	1.59		1.25	0.51	0.40	0.02	0.58	0.09
25	1.50	1.49		0.52	0.49	0.38	0.10	0.79	0.11
26	2.10	0.44		0.71	0.22	0.64	0.06	0.27	0.05
27	1.41	0.30		0.00	0.10	0.39	0.00	0.15	0.03
28	3.13	1.03		0.44	0.42	1.23	0.18	0.24	0.05

Table 51. Major ions in the Edmonton atmosphere, February 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.76	0.11		0.50	0.10	0.00	0.00	0.02	0.00
2	0.97	0.12		0.61	0.11	0.04	0.00	0.06	0.01
3	0.66	0.16		0.55	0.15	0.03	0.00	0.03	0.00
4	0.66	0.09		0.43	0.08	0.02	0.03	0.00	0.00
5	0.35	0.13		0.54	0.12	0.00	0.03	0.05	0.01
6	2.85	2.09		0.58	2.28		0.03	0.07	0.00
7	0.33	0.10		0.51	0.01	0.00	0.00	0.02	0.00
8	0.30	0.18		0.61	0.11	0.02	0.01	0.06	0.00
9	0.83	0.21		0.65	0.15	0.02	0.02	0.06	0.02
10	0.49	0.19		0.40	0.01	0.03	0.00	0.02	0.01
11	0.36	0.19		0.54	0.11	0.01	0.00	0.04	0.01
12	0.40	0.12		0.41	0.03	0.01	0.00	0.01	0.01
13	0.32	0.17		0.55	0.09	0.02	0.03	0.04	0.01
14	0.20	0.15		0.70	0.47	0.01	0.00	0.08	0.01
15	1.68	1.58		0.53	0.15	0.02	0.01	0.06	0.01
16	0.19	0.11		0.39	0.00	0.04	0.00	0.01	0.00
17	0.18	0.12		0.46	0.02	0.00	0.00	0.14	0.00
18	0.01	0.18		0.42	0.00	0.02	0.00	0.04	0.00
19	0.49	0.10		0.49	0.07	0.00	0.02	0.07	0.00
20	0.50	0.16		0.60	0.19	0.00	0.02	0.21	0.02
21	0.65	0.14		0.56	0.06	0.00	0.02	0.08	0.01
22	0.04	0.11		0.55	0.11	0.08	0.26	0.15	0.03
23	0.61	0.11		0.38	0.00	0.00	0.00	0.01	0.00
24	0.67	0.12		0.45	0.00	0.00	0.00	0.01	0.00
25	0.71	0.11		0.52	0.12	0.00	0.07	0.07	0.01
26	0.57	0.11		0.49	0.07	0.00	0.04	0.04	0.01
27	0.40	0.12		0.00	0.00	0.00	0.00	0.05	0.01
28	0.63	0.08		0.23	0.00	0.00	0.00	0.02	0.01

Table 52. Major ions in the Edmonton atmosphere, February 1983 (0000 2400) - teflon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	2.34	2.62		0.86	0.24	1.77	0.05	0.28	0.04
2	2.36	3.52		0.28	0.18	1.77	0.00	0.36	0.03
3	2.01	1.47		0.24	0.15	0.97	0.01	0.18	0.04
4	2.04	1.58		0.41	0.24	1.43	0.01	0.21	0.06
5	2.45	3.47		1.16	0.97	1.88	0.04	0.60	0.11
6	2.84	3.42		1.39	2.05	2.41	0.02	0.63	0.12
7	1.15	0.89		0.60	0.50	0.46	0.00	0.18	0.02
8	2.35	3.11		1.44	2.56	1.35	0.03	0.85	0.13
9	3.11	4.28		1.33	1.75	3.03	0.04	0.69	0.12
10	3.02	4.75		1.04	1.05	3.14	0.05	0.45	0.06
11	2.21	3.90		1.32	2.59	1.61	0.03	0.56	0.06
12	1.26	4.55		1.26	1.89	1.61	0.03	0.42	0.05
13	0.93	3.71		1.31	1.89	0.92	0.05	0.55	0.07
14	0.52	1.73		1.59	6.01	0.85	0.07	1.29	0.12
15	0.44	0.49		1.50	4.99	0.44	0.06	1.22	0.08
16	1.32	0.37		1.23	1.19	0.49	0.00	0.67	0.11
17	1.48	0.62		1.16	1.21	0.57	0.13	0.63	0.11
18	2.50	2.51		1.38	2.19	1.22	0.04	1.35	0.21
19	1.79	2.00		1.30	1.58	0.91	0.00	0.55	0.09
20	2.69	4.84		1.55	4.39	1.89	0.02	1.90	0.23
21	0.53	0.83		1.43	2.56	0.14	0.06	1.46	0.19
22	0.97	3.53		1.31	1.52	0.68	0.04	0.98	0.13
23	0.67	1.76		0.33	0.24	0.53	0.00	0.36	0.05
24	0.93	1.47		0.80	0.51	0.40	0.02	0.57	0.09
25	0.79	1.38		0.00	0.37	0.38	0.03	0.72	0.10
26	1.53	0.32		0.22	0.15	0.64	0.02	0.23	0.04
27	1.01	0.18		0.00	0.10	0.39	0.00	0.10	0.02
28	2.50	0.95		0.21	0.42	1.23	0.18	0.22	0.04

Table 53. Major ions in the Edmonton atmosphere, March 1983 (0000 2400) - total of teflon and nylon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	5.77	2.50		0.54	0.26	4.96	0.07	0.24	0.05
2	3.11	1.16		0.48	0.25	1.10	0.11	0.35	0.06
3	2.68	1.25		0.40	0.22	1.17	0.05	0.15	0.03
4	2.87	1.15		1.02	0.56	1.19	0.14	0.28	0.05
5	2.60	0.66		0.71	0.41	0.96	0.08	0.12	0.04
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24	1.99	0.87		0.92	0.44	2.25	0.10	0.38	0.07
25	2.07	1.44		2.30	1.62	0.76	0.11	1.02	0.16
26	3.70	2.97		2.09	1.37	1.96	0.03	0.91	0.14
27	1.66	1.33		0.89	0.49	0.72	0.04	0.39	0.05
28	2.96	1.77		1.80	4.02	1.09	0.05	1.37	0.20
29	3.72	2.59		1.57	0.98	1.41	0.06	1.33	0.20
30									
31									

Table 54. Major ions in the Edmonton atmosphere, March 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.70	0.09		0.25	0.03	0.00	0.00	0.01	0.00
2	0.72	0.11		0.31	0.08	0.00	0.03	0.03	0.01
3	0.51	0.08		0.26	0.02	0.02	0.00	0.02	0.00
4	0.54	0.11		0.42	0.14	0.00	0.03	0.07	0.01
5	0.43	0.10		0.23	0.00	0.00	0.00	0.00	0.00
6	0.45	0.23		0.21					
7	0.52	0.26		0.24					
8	0.75	2.53		0.24					
9	0.61	0.24		0.23					
10	1.10	0.30		0.29					
11	0.81	0.69		0.22					
12	0.58	0.23		0.19					
13	0.40	0.24		0.22					
14	0.60	0.20		0.19					
15	0.34	0.16		0.19					
16	0.28	0.17		0.25					
17	0.61	0.26		0.24					
18	0.29	0.22		0.26					
19	0.18	0.18		0.24					
20	0.77	0.22		0.27					
21	4.39	0.13		0.15					
22	0.61	0.14		0.18					
23	0.78	0.30		0.21					
24	0.64	0.09		0.29	0.06	0.00	0.07	0.05	0.01
25	0.59	0.31		0.38	0.12	0.04	0.03	0.07	0.01
26	0.56	0.21		0.39	0.01	0.00	0.00	0.01	0.00
27	0.56	0.26		0.33	0.02	0.03	0.02	0.01	0.00
28	0.65	0.20		0.38	3.02	0.00	0.00	0.08	0.00
29	0.91	0.24		0.33	0.04	0.00	0.00	0.03	0.01
30	0.84	0.50		0.25					
31	0.54	0.23		0.22					

Table 55. Major ions in the Edmonton atmosphere, March 1983 (0000 2400) - teflon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	5.27	2.41		0.29	0.23	4.96	0.07	0.23	0.05
2	2.39	1.05		0.17	0.17	1.10	0.08	0.32	0.05
3	2.17	1.17		0.14	0.20	1.15	0.05	0.13	0.03
4	2.32	1.04		0.60	0.42	1.19	0.11	0.21	0.04
5	2.17	0.56		0.48	0.41	0.96	0.08	0.12	0.04
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24	1.36	0.78		0.63	0.38	2.25	0.03	0.33	0.06
25	1.48	1.13		1.92	1.50	0.72	0.08	0.95	0.15
26	3.24	2.76		1.70	1.36	1.96	0.03	0.90	0.14
27	1.10	1.07		0.56	0.47	0.69	0.02	0.38	0.05
28	2.31	1.57		1.42	1.00	1.09	0.05	1.29	0.20
29	2.81	2.35		1.24	0.94	1.41	0.06	1.30	0.19
30									
31									

Table 56. Major ions in the Edmonton atmosphere, April 1983 (0000 2400) - total of teflon and nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	1.12	2.25		0.54					
2	1.05	0.65		0.72					
3	1.47	1.27		0.48					
4									
5	1.94	2.48		1.07					
6	0.80	1.47		1.10					
7	2.14	2.03		0.88					
8	0.47	0.41		0.42					
9	0.45	0.47		0.33					
10	1.11	0.57		0.43					
11	0.99	1.06		1.10					
12	3.09	3.17		1.32					
13	1.23	1.61		1.44					
14	0.57	0.70		1.23					
15	1.05	1.63		1.28		0			
16	0.76	0.86		1.12		0			
17	0.41	0.75		0.88		0			
18	0.62	0.99		0.91		0			
19	0.77	1.53		1.00		0			
20	0.86	0.95		0.66		0			
21	1.64	1.10		0.83		0.29			
22	0.86	0.78		0.60		0			
23	1.07	1.25		0.69		0.55			
24	0.56	0.66		0.69		0.05			
25	0.46	0.41		0.53		0			
26	0.38	0.33		0.49		0			
27	1.75	0.64		0.59		0.40			
28									
29	0.18	0.23		0.46		0.01			
30	0.05	0.21		0.15		0			

Table 57. Major ions in the Edmonton atmosphere, April 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.39	0.27		0.24					
2	0.36	0.19		0.27					
3	0.42	0.17		0.21					
4	0.34	0.25		0.23					
5	0.49	0.24		0.28					
6	0.21	0.37		0.25					
7	0.65	0.06		0.24					
8	0.27	0.20		0.22					
9	0.12	0.14		0.18					
10	0.69	0.15		0.12					
11	0.28	0.18		0.18					
12	0.23	0.20		0.24					
13	0.37	0.34		0.30					
14	0.14	0.20		0.28					
15	0.27	0.36		0.31		0			
16	0.10	0.23		0.29		0			
17	0.12	0.28		0.24		0			
18	0.12	0.33		0.26		0			
19	0.13	0.57		0.28		0			
20	0.22	0.30		0.28		0			
21	0.25	0.28		0.27		0			
22	0.45	0.28		0.25		0			
23	0.17	0.29		0.28		0			
24	0.09	0.22		0.25		0			
25	0.17	0.16		0.30		0			
26	0.11	0.16		0.31		0			
27	0.61	0.28		0.31		0.04			
28	0.40	0.54				0			
29	0.10	0.13		0.18		0			
30	0.02	0.12		0.10		0			

Table 58. Major ions in the Edmonton atmosphere, April 1983 (0000 2400) - teflon filters. (All values given in µg/m³.)

	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
Day									
1	0.73	1.98		0.30					
2	0.69	0.46		0.45					
3	1.05	1.10		0.27					
4									
5	1.45	2.24		0.79					
6	0.59	1.10		0.85					
7	1.49	1.97		0.64					
8	0.20	0.21		0.20					
9	0.33	0.33		0.15					
10	0.42	0.42		0.31					
11	0.71	0.88		0.92		0.12			
12	2.86	2.97		1.08		2.81			
13	0.86	1.27		1.14		0			
14	0.43	0.50		0.95		0			
15	0.78	1.27		0.97		0			
16	0.66	0.63		0.83		0			
17	0.29	0.47		0.64		0			
18	0.50	0.66		0.65		0			
19	0.64	0.96		0.72		0			
20	0.64	0.65		0.38		0			
21	1.39	0.82		0.56		0.29			
22	0.41	0.50		0.35		0			
23	0.90	0.96		0.41		0.55			
24	0.47	0.44		0.44		0.05			
25	0.29	0.25		0.23		0			
26	0.27	0.17		0.18		0			
27	1.14	0.36		0.28		0.36			
28	1.55	2.69		0.65		2.57			
29	0.08	0.10		0.28		0			
30	0.03	0.09		0.05		0			

Table 59. Major ions in the Edmonton atmosphere, May 1983 (0000 2400) - total of teflon and nylon filters. (All values given in µg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.02	0.04		0.07		0			
2	0.32	0.23		0.26		0			
3	1.21	0.86		0.41		0.23			
4	0.44	0.55		0.46		0			
5	1.28	1.08		0.49		0.08			
6	1.06	0.77		0.37		0.23			
7	0.58	0.59		0.38		0			
8	0.44	0.36		0.32		0			
9	0.58	0.34		0.39		0.02			
10	0.91	1.12		0.42		0			
11	0.66	0.44		0.28		0			
12	0.78	0.97		0.33		0			
13	0.96	0.44		0.08		0.02			
14	0.44	0.45		0.27		0			
15	0.69	0.88		0.28		0			
16	1.04	0.84		0.31		0.24			
17	0.72	0.63		0.35		0			
18	0.47	0.36		0.16		0			
19	0.60	0.41		0.29		0			
20	0.69	0.36		0.28		0			
21	0.61	0.31		0.31		0			
22	0.47	0.73		0.50		0			
23	1.20	0.54		0.36		0.31			
24	0.82	0.95		0.47		0.02			
25	0.59	0.63		0.51		0			
26	0.67	0.64		0.52		0			
27	0.91	1.06		0.55		0.10			
28	0.52	1.21		0.48		0.12			
29	0.59	1.10		0.45		0.10			
30	0.36	0.62		0.39		0			
31	0.54	0.84		0.54		0			

Table 60. Major ions in the Edmonton atmosphere, May 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.01	0.01		0.05		0			
2	0.04	0.04		0.08		0			
3	0.15	0.15		0.20		0			
4	0.16	0.16		0.29		0			
5	0.34	0.34		0.28		0			
6	0.14	0.19		0.27		0			
7	0.28	0.26		0.29		0			
8	0.14	0.19		0.25		0			
9	0.14	0.16		0.28		0			
10	0.12	0.21		0.26		0			
11	0.07	0.15		0.19		0			
12	0.18	0.37		0.21		0			
13	0.42	0.14		0		0			
14	0.13	0.15		0.19		0			
15	0.15	0.22		0.16		0			
16	0.28	0.41		0.22		0			
17	0.24	0.27		0.18		0			
18	0.03	0.02		0		0			
19	0.22	0.16		0.15		0			
20	0.46	0.15		0.15		0			
21	0.40	0.17		0.08		0			
22	0.28	0.26		0.36		0			
23	0.49	0.14		0.28		0			
24	0.22	0.48		0.36		0			
25	0.12	0.18		0.34		0			
26	0.17	0.24		0.34		0			
27	0.25	0.47		0.34		0			
28	0.12	0.52		0.36		0			
29	0.09	0.50		0.33		0			
30	0.05	0.24		0.32		0			
31	0.13	0.25		0.34		0			

Table 61. Major ions in the Edmonton atmosphere, May 1983 (0000 2400) - teflon filters. (All values given in μg/m³.)

	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
Day									
1	0.01	0.03		0.02		0			
2	0.28	0.19		0.18		0			
3	1.06	0.71		0.21		0.23			
4	0.28	0.39		0.17		0			
5	0.94	0.74		0.21		0.08			
6	0.92	0.58		0.10		0.23			
7	0.30	0.33		0.09		0			
8	0.30	0.17		0.07		0			
9	0.44	0.18		0.11		0.02			
10	0.79	0.40		0.16		0			
11	0.59	0.29		0.09		0			
12	0.60	0.60		0.12		0			
13	0.54	0.30		0.08		0.02			
14	0.31	0.30		0.08		0			
15	0.54	0.66		0.12		0			
16	0.76	0.43		0.09		0.24			
17	0.48	0.36		0.17		0			
18	0.44	0.34		0.16		0			
19	0.38	0.25		0.14		0			
20	0.23	0.21		0.13		0			
21	0.21	0.14		0.23		0			
22	0.19	0.17		0.14		0			
23	0.71	0.40		0.08		0.31			
24	0.60	0.47		0.11		0.02			
25	0.47	0.45		0.17		0			
26	0.50	0.40		0.18		0			
27	0.66	0.59		0.21		0.10			
28	0.40	0.69		0.12		0.12			
29	0.50	0.60		0.12		0.10			
30	0.31	0.38		0.07		0			
31	0.41	0.59		0.20		0			

Table 62. Major ions in the Edmonton atmosphere, June 1983 (0000 2400) - total of teflon and nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.57	0.51		0.45		0			
2	1.01	0.37		0.48		0.23			
3	2.04	0.63		0.56		0.92			
4	0.70	0.82		0.43		0.22			
5	0.60	1.09		0.44		0.05			
6	0.59	0.68		0.42		0			
7	0.71	0.40		0.46		0			
8	0.71	1.04		0.58		0.03			
9	0.50	0.68		0.53		0			
10	0.96	1.18		0.55		0.06			
11	0.29	0.30		0.34		0			
12	0.32	0.35		0.42		0			
13	0.83	0.44		0.49		0			
14	0.65	0.81		0.49		0.01			
15	0.27	0.68		0.13		0			
16	0.75	1.56		0.48		0.09			
17	0.62	1.13		0.58		0			
18	0.71	0.38		0.35		0			
19	0.77	0.29		0.45		0			
20	0.53	0.17		0.44		0			
21	1.92	0.65		0.77		0.18			
22	2.25	0.73		0.74		0.69			
23	1.27	0.60		0.43		0			
24	1.33	0.64		0.45		0.06			
25	0.82	0.26		0.39		0			
26	1.58	0.58		0.75		0.02			
27	1.11	0.42		0.66		0.11			
28	0.60	0.97		0.53		0.20			
29	1.50	0.70		0.43		0.32			
30	2.27	0.44		0.15		0.29			

Table 63. Major ions in the Edmonton atmosphere, June 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.29	0.30		0.34		0			
2	0.28	0.18		0.32		0			
3	0.29	0.25		0.33		0			
4	0.11	0.38		0.33		0			
5	0.18	0.41		0.34		0			
6	0.31	0.38		0.33		0			
7	0.34	0.17		0.29		0			
8	0.10	0.49		0.37		0			
9	0.23	0.28		0.26		0			
10	0.38	0.49		0.31		0			
11	0.17	0.19		0.29		0			
12	0.17	0.21		0.32		0			
13	0.45	0.20		0.29		0			
14	0.18	0.41		0.33		0			
15	0.08	0.43		0		0			
16	0.30	0.57		0.33		0			
17	0.19	0.51		0.37		0			
18	0.52	0.18		0.25		0			
19	0.63	0.15		0.35		0			
20	0.44	0.11		0.35		0			
21	0.96	0.11		0.31		0			
22	0.72	0.26		0.48		0			
23	0.99	0.30		0.33		0			
24	0.92	0.19		0.30		0			
25	0.59	0.16		0.29		0			
26	1.09	0.33		0.51		0			
27	0.74	0.16		0.29		0			
28	0.55	0.43		0.35		0			
29	0.67	0.38		0.33		0			
30	1.33	0.11		0		0			

Table 64. Major ions in the Edmonton atmosphere, June 1983 (0000 2400) - teflon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.28	0.21		0.11		0			
2	0.73	0.19		0.16		0.23			
3	1.75	0.38		0.23		0.92			
4	0.59	0.44		0.10		0.22			
5	0.42	0.68		0.10		0.05			
6	0.28	0.30		0.09		0			
7	0.37	0.23		0.17		0			
8	0.61	0.55		0.21		0.03			
9	0.27	0.40		0.27		0			
10	0.58	0.69		0.24		0.06			
11	0.12	0.11		0.05		0			
12	0.15	0.14		0.10		0			
13	0.38	0.24		0.20		0			
14	0.47	0.40		0.16		0.01			
15	0.19	0.25		0.13		0			
16	0.45	0.99		0.15		0.09			
17	0.43	0.62		0.21		0			
18	0.19	0.20		0.10		0			
19	0.14	0.14		0.10		0			
20	0.09	0.06		0.09		0			
21	0.96	0.54		0.46		0.18			
22	1.53	0.47		0.26		0.69			
23	0.28	0.30		0.10		0			
24	0.41	0.45		0.15		0.06			
25	0.23	0.10		0.10		0			
26	0.49	0.25		0.24		0.02			
27	0.37	0.26		0.37		0.11			
28	0.05	0.54		0.18		0.20			
29	0.83	0.32		0.10		0.32			
30	0.94	0.33		0.15		0.29			

Table 65. Major ions in the Edmonton atmosphere, July 1983 (0000 2400) - total of teflon and nylon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2	1.11	0.36		0.31	0.11	0	0.21	1.00	0.09
3	0.80	0.42		0.42	0.05	0.09	0.07	0.77	0.09
4	0.90	0.48		0.22	0.05	0.37	0.06	0.68	0.16
5	0.66	0.48		0.23	0.03	0.16	0.03	0.51	0.08
6	0.44	0.27		0.17	0.01	0	0.03	0.45	0.06
7	0.58	0.28		0.19	0.07	0	0.07	0.49	0.06
8	0.80	0.27		0.18	0.04	0	0.05	0.61	0.07
9	0.45	0.21		0.24	0.06	0.02	0.05	0.50	0.06
10	0.27	0.22		0.21	0.03	0	0.08	0.49	0.06
11	0.27	0.24		0.20	0.03	0	0.04	0.43	0.05
12									
13	6.08	4.99		0.93	1.01	0.51	0.55	9.28	1.27
14	3.40	2.07		1.57	0.33	0	0.68	8.86	1.10
15									
16	0.77	0.43		0.69	0.10	0.05	0.12	0.97	0.14
17	0.87	0.64		0.84	0.26	0.08	0.39	1.16	0.19
18	3.03	3.06		1.50	0.41	0.51	0.17	3.79	0.57
19									
20	4.97	4.23		0.65	0.53	0.80	0.48	5.48	1.01
21	1.94	0.98		0.15	0.39	0	0.25	5.63	0.70
22	3.33	2.54		0.37	0.43	0.33	0.42	5.43	0.86
23	1.90	1.43		0.21	0.52	0.38	0.30	2.68	0.41
24	2.98	1.55		0.08	0.20	0.59	0.11	1.44	0.26
25									
26									
27	2.79	1.73		0.35	1.21	0.02	0.62	7.35	0.81
28	7.06	4.30		0.73	1.86	0.43	1.36	13.23	1.10
29									
30									
31									

Table 66. Major ions in the Edmonton atmosphere, July 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2	0.83	0.13		0.23	0.02	0	0.14	0.21	0.02
3	0.38	0.26		0.32	0	0	0.04	0.27	0.02
4	0.27	0.24		0.14	0	0	0.02	0.14	0.02
5	0.27	0.29		0.17	0	0	0.01	0.11	0.01
6	0.31	0.12		0.14	0	0	0.01	0.08	0.01
7	0.40	0.14		0.13	0.01	0	0.02	0.11	0.01
8	0.53	0.10		0.13	0.01	0	0.02	0.06	0.01
9	0.26	0.11		0.16	0	0	0.01	0.10	0.01
10	0.16	0.13		0.16	0.01		0.05	0.09	0.01
11	0.17	0.10		0.15	0	0	0.02	0.08	0.01
12									
13	2.23	2.01		0	0.02	0	0.17	2.39	0.43
14	1.67	0.68		1.01	0.01	0	0.30	2.29	0.42
15									
16	0.51	0.24		0.66	0.07	0	0.04	0.27	0.04
17	0.42	0.38		0.69	0.05	0	0.08	0.27	0.05
18	1.15	2.06		1.06	0.06	0	0	0.61	0.15
19									
20	2.72	1.37		0	0.01	0	0.04	0.49	0.05
21	1.81	0.56		0	0.07	0	0.01	0.53	0.13
22	1.64	1.25		0	0.02	0	0	0.61	0.14
23	0.56	0.82		0	0.05	0	0.01	0.35	0.05
24	0.96	0.76		0	0.02	0	0	0.07	0.03
25									
26									
27	1.52	0.90		0	0	0	0.30	2.06	0.32
28	4.95	2.37		0.43	1.58	0	0.89	2.86	0.34
29									
30									
31									

Table 67. Major ions in the Edmonton atmosphere, July 1983 (0000 2400) - teflon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2	0.28	0.23		0.08	0.09	0	0.07	0.79	0.07
3	0.42	0.16		0.10	0.05	0.09	0.03	0.50	0.07
4	0.63	0.24		0.08	0.05	0.37	0.04	0.54	0.14
5	0.39	0.19		0.06	0.03	0.16	0.02	0.40	0.07
6	0.13	0.15		0.03	0.01	0	0.02	0.37	0.05
7	0.18	0.14		0.06	0.06	0	0.05	0.38	0.05
8	0.27	0.14		0.05	0.03	0	0.03	0.55	0.06
9	0.19	0.10		0.08	0.06	0.02	0.04	0.40	0.05
10	0.11	0.09		0.05	0.02	0	0.03	0.40	0.05
11	0.10	0.14		0.05	0.03	0	0.02	0.35	0.04
12									
13	3.85	2.97		0.93	0.99	0.51	0.38	6.89	0.84
14	1.73	1.39		0.56	0.32	0	0.38	6.57	0.68
15									
16	0.26	0.19		0.06	0.04	0.05	0.08	0.70	0.10
17	0.45	0.26		0.15	0.21	0.08	0.31	0.89	0.14
18	1.88	1.02		0.44	0.35	0.51	0.17	3.18	0.42
19	4.26	3.03		0.50	0.67	1.27	0.60	6.23	0.91
20	2.25	2.86		0.74	0.52	0.80	0.43	4.99	0.76
21	0.86	0.42		0.15	0.32	0	0.24	5.10	0.57
22	1.69	1.29		0.37	0.41	0.33	0.42	4.82	0.72
23	1.34	0.61		0.21	0.47	0.38	0.29	2.33	0.36
24	2.02	0.79		0.08	0.18	0.59	0.11	1.37	0.23
25									
26									
27	1.27	0.83		0.35	1.21	0.02	0.28	5.29	0.49
28	1.91	1.93		0.30	0.28	0.43	0.47	10.37	0.78
29									
30									
31									

Table 68. Major ions in the Edmonton atmosphere, August 1983 (1200 2400) - total of teflon and nylon filters. (All values given in μg/m³.)

	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
Day									
1	1.24	0.77		0.03		0.36		0.84	0.11
2	1.26	0.88		0.05	0.52	0.40	0.22	1.03	0.13
3	0.45	0.26		0.02	0.04	0.74	0.05	0.27	0.03
4	0.87	0.61		0.10	0.09	0.00	0.07	1.09	0.12
5	0.13	0.08		0.21	0.11	0.00	0.10	0.22	0.03
6	0.07	0.05		0.07	0.04	0.00	0.02	0.15	0.03
7	0.08	0.08		0.03	0.04	0.00	0.05	0.30	0.04
8	4.45	4.47		0.48	0.50	1.54	0.44	3.66	4.17
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									

Table 69. Major ions in the Edmonton atmosphere, August 1983 (1200 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.27	0.40		0.00		0.00		0.07	0.01
2	0.52	0.47		0.00	0.00	0.05	0.00	0.02	0.00
3	0.28	0.16		0.00	0.00	0.00	0.01	0.04	0.00
4	0.43	0.17		0.00	0.00	0.00	0.00	0.02	0.00
5	0.07	0.06		0.00	0.02	0.00	0.03	0.07	0.01
6	0.03	0.04		0.00	0.00	0.00	0.01	0.04	0.01
7	0.05	0.06		0.00	0.03	0.00	0.04	0.19	0.03
8	0.60	2.01		0.00	0.00	0.24	0.00	0.14	0.01
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									

Table 70. Major ions in the Edmonton atmosphere, August 1983 (1200 2400) - teflon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	0.97	0.37		0.03	0.07	0.36	0.09	0.77	0.10
2	0.74	0.41		0.05	0.52	0.35	0.22	1.01	0.13
3	0.17	0.10		0.02	0.04	0.07	0.04	0.23	0.03
4	0.44	0.44		0.10	0.09	0.00	0.07	1.07	0.12
5	0.07	0.02		0.21	0.09	0.00	0.07	0.15	0.02
6	0.04	0.01		0.07	0.04	0.00	0.01	0.11	0.02
7	0.02	0.02		0.03	0.01	0.00	0.01	0.11	0.01
8	3.85	2.46		0.48	0.50	1.30	0.44	3.52	4.14
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									

Table 71. Major ions in the Edmonton atmosphere, August 1983 (0000 2400) - total of teflon and nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2									
3									
4									
5									
6									
7									
8									
9	0.87	0.33		0.22	0.23	0.11	0.08	0.69	0.62
10	2.57	2.28		0.57	0.45	0.93	0.24	2.38	1.81
11	2.27	0.95		0.34	0.24	0.58	0.14	2.20	1.32
12	1.13	0.46		0.12	0.09	0.13	0.15	1.84	1.92
13	1.32	1.06		0.05	0.13	0.22	0.11	3.25	3.36
14	0.83	0.54		0.05	0.05	0.16	0.09	1.47	0.95
15	1.35	1.72		0.08	0.07	0.36	0.11	2.70	1.28
16	1.94	1.57		0.14	0.11	0.59	0.15	2.28	1.36
17	1.47	0.86		0.08	0.12	0.31	0.08	1.20	1.29
18	0.66	0.25		0.37	0.07	0.12	0.22	1.71	1.79
19	1.07	0.64		0.56	0.19	0.17	0.11	1.28	1.29
20	0.87	0.41		0.40	0.03	0.31	0.06	0.56	0.60
21	0.87	0.60		0.46	0.09	0.09	0.10	2.03	2.08
22	1.34	2.14		0.63	0.08	0.71	0.10	1.57	1.64
23	2.44	2.38		0.46	0.10	0.78	0.10	2.37	2.49
24	2.04	2.13		0.66	0.11	0.84	0.19	1.51	1.67
25	2.63	1.28		0.62	0.00	0.68	0.00	1.86	2.00
26	3.33	2.40		0.69	0.09	1.18	0.13	1.63	1.79
27	1.63	0.96		0.48	0.05	0.58	0.09	0.88	0.94
28	1.80	1.30		0.46	0.05	0.87	0.16	0.82	0.88
29	2.15	1.78		0.87	0.49	0.73	0.22	2.68	2.89
30	3.50	2.87		0.31	0.36	1.02	0.24	3.26	3.24
31	3.21	2.66		0.85	0.20	1.08	0.25	3.36	3.54

Table 72. Major ions in the Edmonton atmosphere, August 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2									
3									
4									
5									
6									
7									
8									
9	0.52	0.18		0.00	0.03	0.02	0.02	0.15	0.02
10	0.81	1.44		0.37	0.26	0.19	0.09	0.72	0.18
11	0.57	0.28		0.00	0.01	0.02	0.02	0.02	0.01
12	0.46	0.18		0.00	0.00	0.01	0.04	0.02	0.00
13	0.35	0.29		0.00	0.05	0.01	0.01	0.02	0.00
14	0.37	0.38		0.00	0.01	0.01	0.04	0.61	0.00
15	0.41	0.95		0.00	0.00	0.04	0.01	1.54	0.02
16	0.49	0.41		0.00	0.00	0.14	0.04	0.03	0.01
17	0.55	0.31		0.00	0.06	0.02	0.02	0.04	0.01
18	0.20	0.09		0.29	0.00	0.01	0.11	0.02	0.00
19	0.31	0.23		0.46	0.10	0.00	0.01	0.12	0.02
20	0.34	0.27		0.36	0.00	0.03	0.02	0.02	0.00
21	0.17	0.24		0.35	0.01	0.01	0.02	0.02	0.00
22	0.18	1.08		0.53	0.00	0.25	0.01	0.06	0.01
23	0.33	0.92		0.35	0.00	0.20	0.02	0.07	0.01
24	0.24	0.80		0.56	0.00	0.18	0.03	0.02	0.00
25	0.43	0.43		0.44	0.00	0.06	0.00	0.02	0.00
26	0.50	1.13		0.54	0.00	0.31	0.00	0.02	0.00
27	0.23	0.42		0.41	0.00	0.07	0.01	0.04	0.00
28	0.24	0.69		0.38	0.00	0.18	0.05	0.04	0.00
29	0.31	0.68		0.35	0.12	0.18	0.03	0.05	0.00
30	0.73	0.64		0.00	0.12	0.06	0.03	0.39	0.08
31	0.65	1.00		0.61	0.05	0.28	0.09	0.12	0.01

Table 73. Major ions in the Edmonton atmosphere, August 1983 (0000 2400) - teflon filters. (All values given in μg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1									
2									
3									
4									
5									
6									
7									
8									
9	0.34	0.16		0.22	0.20	0.09	0.06	0.54	0.08
10	1.76	0.84		0.20	0.19	0.64	0.15	1.66	0.15
11	1.70	0.67		0.34	0.23	0.56	0.12	1.18	0.14
12	0.68	0.28		0.12	0.09	0.12	0.11	1.82	0.10
13	0.96	0.76		0.05	0.08	0.22	0.10	3.23	0.13
14	0.46	0.26		0.05	0.04	0.15	0.05	0.86	0.09
15	0.94	0.78		0.08	0.07	0.32	0.10	1.16	0.12
16	1.46	1.16		0.14	0.11	0.45	0.11	2.25	0.11
17	0.92	0.55		0.08	0.06	0.29	0.06	1.18	0.11
18	0.46	0.16		0.08	0.07	0.11	0.11	1.69	0.10
19	0.76	0.41		0.10	0.09	0.17	0.10	1.16	0.13
20	0.53	0.15		0.04	0.03	0.28	0.04	0.54	0.06
21	0.70	0.35		0.11	0.08	0.08	0.08	2.01	0.07
22	1.16	1.06		0.10	0.08	0.46	0.09	1.51	0.13
23	2.11	1.46		0.11	0.10	0.58	0.08	2.30	0.19
24	1.80	1.33		0.10	0.11	0.66	0.16	1.49	0.18
25	2.20	0.85		0.18		0.62		1.84	0.16
26	2.83	1.27		0.15	0.09	0.87	0.13	1.61	0.18
27	1.40	0.55		0.07	0.05	0.51	0.08	0.84	0.10
28	1.56	0.61		0.08	0.05	0.69	0.11	0.78	0.10
29	1.84	1.11		0.52	0.37	0.55	0.19	2.63	0.26
30	2.77	2.23		0.31	0.24	0.96	0.21	2.87	0.37
31	2.56	1.66		0.24	0.15	0.80	0.16	3.24	0.30

Table 74. Major ions in the Edmonton atmosphere, September 1983 (0000 2400) - total of teflon and nylon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	2.09	1.66		0.87	0.39	0.46	0.26	2.51	0.31
2	1.45	0.42		0.52	0.31	0.26	0.16	0.92	0.11
3	0.52	0.28		0.60	0.29	0.06	0.09	0.75	0.09
4	0.48	0.24		0.08	0.05	0.05	0.06	0.55	0.05
5	0.57	0.16		0.39	0.23	0.11	0.20	0.34	0.04
6									
7	1.02	0.42		0.39	0.18	0.14	0.23	1.96	0.17
8	1.35	0.55		0.38	0.07	0.10	0.09	0.93	0.11
9	0.81	0.26		0.39	0.06	0.18	0.06	0.77	0.09
10	1.57	1.03		0.39	0.13	0.42	0.11	1.07	0.16
11	1.59	0.94		0.37	0.08	0.61	0.06	0.81	0.11
12	3.76	1.41		0.50	0.09	0.58	0.07	3.03	0.21
13	1.52	0.80		0.37	0.18	0.39	0.11	1.27	0.17
14	1.85	0.79		0.44	0.10	0.35	0.04	3.96	0.15
15	2.07	2.05		0.48	0.11	0.61	0.10	2.43	0.26
16	1.67	1.66		0.36	0.11	0.52	0.09	1.79	0.14
17	0.36	0.24		0.26	0.05	0.03	0.11	1.10	0.06
18	0.05	0.17		0.24	0.03	0.13	0.04	0.52	0.04
19	0.26	0.26		0.55	0.14	0.03	0.24	0.72	0.09
20	0.98	0.87		0.42	0.12	0.07	0.11	1.74	0.20
21	1.66	1.13		0.44	0.56	0.34	0.09	2.67	0.22
22	2.01	1.37		0.51	0.25	0.71	0.38	1.69	0.22
23	1.54	1.47		0.61	0.34	0.41	0.49	3.74	0.32
24	1.45	1.75		0.50	0.19	0.48	0.30	2.73	0.23
25	1.82	2.10		0.46	0.25	0.86	0.71	2.40	0.24
26				0.62	0.41	0.39	0.24	4.20	0.34
27	0.84	0.45		0.56	0.39	0.11		1.81	0.17
28	0.52	0.53		0.54	0.32	0.11	0.35	2.84	0.21
29	1.98	2.27		0.82	0.40	0.65	0.41	3.03	0.26
30	1.55	2.31		0.72	0.40	0.43	0.40	3.89	0.34

Table 75. Major ions in the Edmonton atmosphere, September 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
Day									
1	0.61	0.63		0.58	0.11	0.08	0.09	0.22	0.03
2	0.66	0.21		0.43	0.06	0.01	0.04	0.19	0.03
3	0.27	0.16		0.40	0.05	0.01	0.02	0.22	0.03
4	0.26	0.10		0.00	0.02	0.00	0.02	0.03	0.00
5	0.35	0.08		0.32	0.18	0.05	0.15	0.06	0.01
6									
7	0.29	0.15		0.25	0.05	0.00	0.07	0.02	0.00
8	0.42	0.10		0.23	0.01	0.00	0.02	0.01	0.00
9	0.35	0.09		0.24	0.01	0.00	0.01	0.02	0.00
10	0.48	0.34		0.27	0.04	0	0.03	0.09	0.01
11	0.39	0.49		0.27	0.02	0.07	0.02	0.09	0.01
12	0.39	0.41		0.26	0.01	0.02	0.02	0.04	0
13	0.33	0.36		0.25	0.09	0	0.02	0.18	0.02
14	0.39	0.16		0.24	0.05	0	0.01	0.16	0.01
15	0.46	0.45		0.25	0.01	0.04	0.02	0.20	0.03
16	0.64	0.11		0.20	0.04	0	0.03	0.06	0
17	0.25	0.14		0.20	0.03	0	0.03	0.04	0
18	0.12	0.09		0.20	0.01	0	0.03	0.02	0
19	0.06	0.12		0.26	0.05	0	0.18	0.18	0.01
20	0.13	0.26		0.25	0.02	0	0.03	0.09	0.01
21	0.37	0.43		0.27	0.46	0	0.06	0.08	0.01
22	0.38	0.59		0.33	0.12	0.07	0.25	0.10	0.01
23	0.30	0.52		0.29	0.12	0.06	0.16	0.07	0
24	0.24	0.50		0.29	0.05	0.02	0.05	0.07	0
25	0.20	0.75		0.31	0.13	0.08	0.37	0.01	0
26	0.18	0.50		0.34	0.15	0.02	0.15	0.05	0
27	0.19	0.17		0.33	0.18	0	0.11	0.07	0
28	0.18	0.22		0.36	0.12	0	0.14	0.11	0.01
29	0.18	0.43		0.35	0.10	0.01	0.09	0.08	0
30	0.16	0.52		0.33	0.11	0	0.09	0.09	0

Table 76. Major ions in the Edmonton atmosphere, September 1983 (0000 2400) - teflon filters. (All values given in $\mu g/m^3$.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	1.48	1.03		0.29	0.28	0.37	0.17	2.29	0.28
2	0.78	0.22		0.09	0.06	0.25	0.12	0.73	0.08
3	0.26	0.11		0.20	0.24	0.05	0.07	0.53	0.06
4	0.22	0.14		0.08	0.03	0.05	0.04	0.52	0.05
5	0.21	0.08		0.07	0.05	0.06	0.05	0.28	0.03
6	0.58	0.36		0.13	0.15	0.17	0.13	1.18	0.15
7	0.74	0.28		0.14	0.13	0.14	0.16	1.94	0.17
8	0.93	0.45		0.15	0.06	0.10	0.07	0.92	0.11
9	0.46	0.17		0.15	0.05	0.18	0.05	0.75	0.09
10	1.09	0.70		0.12	0.09	0.42	0.08	0.98	0.15
11	1.20	0.45		0.10	0.06	0.54	0.04	0.72	0.10
12	3.37	1.00		0.24	0.08	0.57	0.05	2.99	0.21
13	1.19	0.44		0.12	0.09	0.39	0.09	1.09	0.15
14	1.46	0.63		0.20	0.05	0.35	0.03	3.80	0.14
15	1.61	1.60		0.23	0.10	0.57	0.08	2.23	0.23
16	1.03	1.55		0.16	0.07	0.52	0.06	1.73	0.14
17	0.11	0.10		0.06	0.02	0.03	0.08	1.06	0.06
18	0.38	0.08		0.04	0.02	0.13	0.01	0.50	0.04
19	0.20	0.13		0.29	0.09	0.03	0.06	0.54	0.08
20	0.86	0.61		0.17	0.10	0.07	0.08	1.65	0.19
21	1.29	0.70		0.17	0.10	0.34	0.03	2.59	0.21
22	1.63	0.78		0.18	0.13	0.64	0.13	1.59	0.21
23	1.24	0.95		0.32	0.22	0.35	0.23	3.67	0.32
24	1.21	1.25		0.21	0.14	0.46	0.25	2.66	0.23
25	1.61	1.26		0.15	0.12	0.77	0.34	2.39	0.24
26				0.28	0.26	0.36	0.09	4.15	0.34
27	0.65	0.28		0.23	0.21	0.11		1.74	0.17
28	0.33	0.31		0.18	0.20	0.11	0.21	2.73	0.20
29	1.81	1.84		0.47	0.30	0.64	0.32	2.95	0.26
30	1.39	1.82		0.39	0.29	0.43	0.31	3.80	0.34

Table 77. Major ions in the Edmonton atmosphere, October 1983 (0000 2400) - total of teflon and nylon filters. (All values given in µg/m³.)

Day	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
1	1.92	3.10		0.57	0.29	0.84	0.47	2.85	0.29
2	1.36	0.88		0.64	0.27	0.09	0.37	2.68	0.14
3	1.28	1.56		0.73	0.31	0.41	0.30	2.75	0.24
4	0.97	0.49		0.45	0.18	0.08	0.05	4.21	0.27
5	2.48	2.09		0.53	0.14	0.84	0.26	3.30	0.21
6	1.57	2.36		0.54	0.16	0.62	0.16	1.08	0.12
7	3.02	3.31		1.72		1.30		5.93	0.51
8	2.22	2.79		0.77	0.14	1.13	0.23	3.14	0.30
9									
10	0.53	0.65		0.39	0.09	0.20	0.05	2.11	0.10
11	1.38	0.75		0.52	0.20	0.22	0.10	3.17	0.25
12	1.21	1.36		0.65	0.20	0.30	0.19	3.03	0.24
13	0.49	0.79		0.39	0.11	0.14	0.15	1.07	0.17
14	1.95	1.79		0.52	0.12	0.59	0.26	1.42	0.18
15									
16	0.76	1.41		0.21					
17	1.77	3.08		0.32					
18	1.68	3.66		0.39					
19	2.04	4.54		0.69					
20	0.51	3.05		0.59					
21	1.07	2.41		0.75					
22	1.14	1.58		0.39					
23	0.36	0.55		0.79					
24	0.43	0.84		0.34					
25	0.58	0.99		0.40					
26	1.73	0.75		0.43					
27	0.83	0.66		0.36					
28	2.90	7.08		0.71					
29	2.25	4.59		0.44					
30	2.43	4.85		0.68					
31	0.98	0.67		1.43					

Table 78. Major ions in the Edmonton atmosphere, October 1983 (0000 2400) - nylon filters. (All values given in μg/m³.)

	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
Day									
1	0.23	0.81		0.34	0.09	0.05	0.13	0.06	0
2	0.30	0.25		0.33	0.09	0	0.13	0.07	0
3	0.26	0.75		0.37	0.09	0.13	0.11	0.12	0.01
4	0.27	0.16		0.27	0.06	0	0.03	0.18	0.02
5	0.48	0.22		0.25	0.01	0.01	0.03	0.11	0.01
6	0.60	0.44		0.25	0.03	0.04	0.04	0.09	0
7	0.66	0.94		0.83		0.17		0.84	0.13
8	0.44	0.76		0.58	0.03	0.13	0.03	0.39	0.04
9									
10	0.12	0.24		0.27	0	0	0	0.06	0
11	0.17	0.30		0.30	0.01	0	0.02	0.06	0
12	0.16	0.54		0.32	0.02	0.04	0	0.13	0
13	0.07	0.20		0.28	0.04	0	0.02	0.04	0
14	0.32	0.18		0.25	0.02	0	0.01	0.05	0
15									
16	0.12	0.20		0.14					
17	0.20	0.23		0.19					
18	0.23	0.35		0.18					
19	0.23	0.41		0.20					
20	0.27	0.61		0.23					
21	0.15	0.54		0.27					
22	0.16	0.46		0.21					
23	0.14	0.29		0.18					
24	0.08	0.24		0.20					
25	0.09	0.25		0.20					
26	0.15	0.20		0.20					
27	0.42	0.16		0.18					
28	0.51	0.40		0.21					
29	0.68	1.12		0.20					
30	0.50	0.38		0.19					
31	0.39	0.27		0.17					

Table 79. Major ions in the Edmonton atmosphere, October 1983 (0000 2400) - teflon filters. (All values given in μg/m³.)

	SO_4^{2-}	NO_3^-	PO_4^{3-}	Cl^-	Na^+	NH_4^+	K^+	Ca^{2+}	Mg^{2+}
Day									
1	1.69	2.29		0.23	0.20	0.80	0.34	2.79	0.39
2	1.06	0.62		0.31	0.18	0.09	0.24	2.61	0.14
3	1.02	0.81		0.36	0.22	0.28	0.19	2.63	0.23
4	0.70	0.33		0.18	0.12	0.08	0.02	4.03	0.25
5	2.00	1.87		0.28	0.13	0.83	0.23	3.19	0.20
6	0.96	1.92		0.29	0.13	0.67	0.12	0.99	0.12
7	2.37	2.37		0.89	0.24	1.14	0.31	5.09	0.38
8	1.78	2.03		0.19	0.11	0.91	0.20	2.75	0.26
9									
10	0.41	0.42		0.12	0.09	0.20	0.05	2.05	0.10
11	1.31	0.45		0.22	0.19	0.22	0.08	3.11	0.25
12	1.05	0.82		0.33	0.18	0.26	0.19	2.90	0.24
13	0.42	0.58		0.11	0.07	0.14	0.13	1.03	0.17
14	1.63	1.61		0.27	0.10	0.59	0.25	1.37	0.18
15									
16	0.64	1.21		0.07					
17	1.57	2.85		0.13					
18	1.45	3.31		0.21					
19	1.81	4.13		0.49					
20	1.24	2.44		0.36					
21	0.92	1.87		0.48					
22	0.98	1.12		0.18					
23	0.22	0.26		0.61					
24	0.35	0.60		0.14					
25	0.49	0.74		0.20					
26	1.58	0.55		0.23					
27	0.41	0.50		0.18					
28	2.39	6.68		0.50					
29	1.57	3.47		0.24					
30	1.93	4.47		0.49					
31	0.59	0.40		1.26					